CANADA

DEPARTMENT OF RESOURCES AND DEVELOPMENT

NATIONAL MUSEUM OF CANADA
BULLETIN No. 123

ANNUAL REPORT OF THE NATIONAL MUSEUM OF CANADA FOR THE FISCAL YEAR 1949-50

1951

Price, $1

Red fox habitat group
(Neg. No. 102138)

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DEPARTMENT OF RESOURCES AND DEVELOPMENT
NATIONAL PARKS BRANCH • NATIONAL MUSEUM OF CANADA

ANNUAL REPORT

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Ottawa, 1951

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CONTENTS

Illustrations

GENERAL ACTIVITIES OF THE NATIONAL MUSEUM OF CANADA

By F. J. Alcock, Chief Curator

The fiscal year 1949–50 was a very important one in the history of the National Museum of Canada and may be said to have inaugurated a new era for it. The Museum began and grew up within the Geological Survey, the oldest scientific branch of the Federal Service, which commenced its work in 1842. In 1920 the two were separated and placed under different directors. They continued, however, to occupy the same building, the Victoria Memorial Museum, and to share some of the same services and even at times the same administration. By a reorganization which became effective in January, 1950, the two passed into different government departments — the Geological Survey into the Department of Mines and Technical Surveys and the National Museum into that of Resources and Development. It is expected that some time in 1950 the Survey will move to new quarters, leaving the Museum room for a much needed expansion of its exhibits and other services.

During the year, field work was carried out by the National Museum in many parts of Canada; collections were added to through gifts and purchases, and as a result of field activities; exhibits were enlarged and improved; reports and bulletins were prepared for publication; and there was expansion in educational work.

Field work in zoology was carried out in northern British Columbia and the Yukon, on Prince Patrick Island of the western Arctic, and in Newfoundland; botanical studies were made on Victoria and Banks Islands in the Arctic, along the east coast of Hudson Bay and the islands of Foxe Basin, and in the Winnipeg-Winnipegosis Lakes area of the Province of Manitoba. Archæological sites were investigated on Cornwallis Island, in northern British Columbia and the Yukon, along the western margin of the Canadian Shield in Manitoba, Saskatchewan, and the Northwest Territories, and similar work was done in southern Ontario. Ethnological studies involving the collection and study of folk-songs and folk-lore were made in Nova Scotia, Quebec, and Ontario. For the botanical work performed on Banks Island and that along the east coast of Hudson Bay and the islands of Foxe Channel, the National Museum wishes to acknowledge the generous assistance afforded by the Geographical Bureau, which bore most of the actual field expenses of two members of the Museum's staff, A. E. Porsild and W. K. W. Baldwin.

The chief item in the way of exhibits completed during the year was a red fox group now on display in the habitat hall. Progress was also made on the painting of a large mural over the wood buffalo group. This panel represents a huge herd of buffalo crossing a river on the western plains. Three large paintings of dinosaurs were finished and hung in the hall of vertebrate palæontology. An interesting mineralogical gift was received from Dr. J. T. Williamson, Tanganyika: a replica of the famous pink diamond which he had presented to H.R.H. the Princess Elizabeth.

In July and August a group of paintings of West Coast Indian life by Judith Morgan was on exhibit in the rotunda of the Museum and aroused a great deal of interest. During the same months a film program "Canada in Colour" was shown in the lecture hall in the afternoons from Monday

to Friday to give visitors to Ottawa an opportunity to see interesting parts of Canada, a feature which had proved very popular during the preceding summer. In addition to the regular series of Wednesday evening lectures, a special lecture on "A Naturalist in the Antarctic," at which Their Excellencies the Governor-General and the Viscountess Alexander of Tunis were present, was given by Lieutenant-Colonel Niall Rankin on March 9. The Saturday morning lectures for children were well attended, and the Macoun Field Club of young naturalists, which had been organized in September, 1948, had a most successful year.

The archæological section was strengthened by the appointment of Dr. Richard S. MacNeish and that of ethnology by the addition of Miss Margaret Sargent and Miss Josephine Hambleton. Miss V. M. Humphreys also joined the staff as a museum assistant in education.

During the year the National Museum issued its Annual Report for 1948–49, a bridging volume of annual reports 1939–47, covering years in which no separate annual reports for the Museum were published, and a bulletin by W. E. Godfrey on "Birds of Lake Mistassini and Lake Albanel." Other bulletins placed in the hands of the printer, some which will be shortly ready for distribution, include "Flora of Bic and the Gaspe Peninsula," by H. J. Scoggan; "Folk-lore of Waterloo County, Ontario," by W. J. Wintemberg; "Botany of Southeastern Yukon Adjacent to the Canol Road," by A. E. Porsild; "Totem Poles" in two volumes, by Marius Barbeau; and "Birds of the Cypress Hills and Flotten Lakes Regions, Saskatchewan," by W. E. Godfrey.

The Chief Curator represented the Department of Mines and Resources at the XVIth Congress of the International Geographical Union held in Lisbon, Portugal, in April. This afforded an opportunity to visit the Museums of Lisbon and of London, England. On November 30 he gave an illustrated lecture on "The Geology of Canada" before the geological faculty and students of the University of Toronto at Toronto; on March 18 a talk on "Portugal" before the Las Americas Club of Ottawa, and on March 24 an address before the Canadian Club of Perth on "The Mineral Resources of Canada." On February 20, as part of the radio program of the Professional Institute of Canada, he gave a broadcast over CKOY on "The National Museum of Canada."

EDUCATIONAL WORK

The varied work in education continued to be one of the important activities of the National Museum. Through it, the scientific work of the Museum is interpreted to educators, school and natural science groups, and to the general public by means of loans of visual material, correspondence, and publications. Although the National Museum concerns itself with adult education, children are its most numerous and inquiring visitors. Thousands of them come every year, with or without their teachers, to learn by seeing things available only in a museum, and some of them find interests which, with proper encouragement, may develop into a life vocation. Information and study material is made available to advanced students of the natural sciences.

Miss M. W. Godwin reports that, in addition to those from Ottawa and vicinity, teachers, normal school students, high and elementary school

pupils came in organized groups from Belleville, Gananoque, North Bay, Pembroke, and Toronto, Ont.; Montebello, Que.; Canton, N.Y.; and from other localities.

During the Boy Scout Jamboree in August, groups of Scouts from Newfoundland to the Yukon, from the United States, and from Cuba visited the National Museum daily with their Scout Leaders. A group of 50 high-school boys from the United Kingdom paid an evening visit to the Museum. In response to requests from local organizations, evening tours of the exhibition halls were arranged after which films were shown in the auditorium.

Those taking part in special Museum activities were 51,561. Visitors to the exhibition halls, representative of many groups of the general public, numbered 169,344. The total attendance during the year, including organized school and other groups, was 229,266.

The afternoon motion picture program, "Canada in Colour," prepared in collaboration with the National Film Board chiefly for tourists visiting the Museum, was again given during July and August and enjoyed increased popularity.

An "Exhibit of the Month," showing material of special or topical interest, on display during the summer attracted so much attention that it is being continued indefinitely. Natural history material, fossil plants, fossil shells, and mineral specimens made up this exhibit.

A special exhibit, illustrating the educational services of the National Museum, was sent for display to the Saskatchewan Teachers' Convention, and a photographic exhibition was arranged for the annual meeting of the Prospectors and Developers Association in Toronto, March 5–8, 1950.

A dozen photographs of natural history subjects were selected from the National Museum collection for entry in Country Life International Exhibition of Wild Life Photography held in London, England, March 20 to April 1, 1950; three of these were accepted by the Selection Committee for the exhibition.

The National Museum collaborated in several C.B.C. coast-to-coast broadcasts on "Prehistoric Canada." The wide interest aroused by these broadcasts was indicated by the number of requests for copies received at the Museum from all parts of Canada and from many localities in the United States.

Twenty pastel drawings by Judith Morgan, a 19-year old Indian girl of Kitwanga, B.C., were on exhibition for two weeks during August. Among them were "Indian in Eagle Head-dress," "Hok-Hok Dance," "Totems at Skeena Crossing," and "Origin of the Wolf Society." Anthropologists at the National Museum were most interested in Miss Morgan's work, which is an authentic and valuable record of the culture of the West Coast Tribes. The exhibit provided an interesting contrast to the art of her ancient ancestors displayed in the Pacific Coast Indian Hall.

Miss Mabel W. Godwin was elected Secretary-Treasurer of the Canadian Museums Association at its Annual Meeting in October.

The National Museum wishes to acknowledge the gift from Imperial Oil Limited of a colour print of the film "The Loon's Necklace," in which masks from the Museum's collection were used in an artistic and original depiction of a British Columbia Indian legend.

National Museum Lectures

The Lecture Committee, consisting of F. J. Alcock, Chairman; W. K. W. Baldwin, W. E. Godfrey, M. F. Goudge, H. M. A. Rice, L. P. M. Rioux, H. J. Scoggan, and Miss M. W. Godwin, Secretary, reports a very successful year. The program is planned to appeal to as many people as possible. That it has a wide appeal is shown by the fact that the audience changes noticeably from week to week. The program for the 1949–50 season was as follows:

Adult Lectures

Maps of the Middle Ages. By Professor George H. Kimble, B.A., M.A., A.K.C., Chairman, Department of Geography, McGill University, Montreal.

Why British Columbia was Discovered. By W. Kaye Lamb, Ph.D., F.R.S.C., Dominion Archivist, Ottawa.

Picturesque Portugal. By F. J. Alcock, Ph.D., F.R.S.C., Chief Curator, National Museum of Canada, Ottawa.

No Man is an Island (motion picture in technicolour). Introduced by A. O. Wolff, Consolidated Mining and Smelting Company of Canada, Limited.

Servants of the People. By Arthur Beauchesne, C.M.G., M.A., K.C., LL.D., F.R.S.C., Ottawa.

Motion Picture Program: The Secret Land and Antarctic Whale Hunt.

The Changing Commonwealth. By R. G. Trotter, M.A., Ph.D., D.C.L., F.R.S.C., the James Douglas Professor of History, Queen's University, Kingston, Ont.

Exploring Mexico's Oldest Habitations. By Richard S. MacNeish, M.A., Ph.D., Archæologist, National Museum of Canada, Ottawa.

The Modern Arctic. By Y. O. Fortier, Ph.D., Geological Survey, Ottawa.

Power and Fuel Under the Prairies. By George S. Hume, O.B.E., Ph.D., F.R.S.C., Director, Mines, Forests and Scientific Services, Department of Mines and Resources, Ottawa.

Motion Picture Program: "Here and There in Canada," shown through the courtesy of the National Film Board, Ottawa.

The Milky Way. By Mrs. Helen Sawyer Hogg, A.M., Ph.D., F.R.S.C., Astronomer, David Dunlap Observatory, Richmond Hill, Ont.

Through Western Europe. By P. O. Ripley, M.Sc., Ph.D., Dominion Field Husbandman, Experimental Farms Service, Ottawa.

North to the Midnight Sun. By Douglas Leechman, B.Sc., M.A., Ph.D., Archæologist, National Museum of Canada, Ottawa.

New Islands in the Arctic. By W. K. W. Baldwin, M.B.E., M.A., Botanist, National Museum of Canada, Ottawa.

Under the Distinguished Patronage of Their Excellencies, the Governor General and the Viscountess Alexander of Tunis, a special illustrated lecture was given on March 9, 1950, by Lieutenant-Colonel Niall Rankin, F.R.P.S., who chose as his subject, "A Naturalist in the Arctic."

Children's Lectures

Motion Picture Program: Elephant Boy.

My Seeing Eye Dog. By Mrs. David Crombie, Westmount, Que.

A Story About Insects. By Stanton D. Hicks, Department of Agriculture, Ottawa.

Animals and Birds in Newfoundland. By Austin W. Cameron, M.A., National Museum of Canada, Ottawa.

Children of Other Lands—Britain: in collaboration with the Citizens Committee for Children, Ottawa.

Snakes, Frogs, and Turtles. By Clyde L. Patch, National Museum of Canada, Ottawa.

Children Around the World. By Richard S. MacNeish, Ph.D., National Museum of Canada, Ottawa.

Arctic Explorers. By Y. O. Fortier, Ph.D., Geological Survey, Ottawa.

Down to the Sea at Fundy. By F. J. Alcock, Ph.D., National Museum of Canada, Ottawa.

Motion Picture Program of Selected Short Subjects.

Come a Singing. By Margaret Sargent, National Museum of Canada, Ottawa, assisted by Marjorie Butterworth and pupils of Glashan School.

Let's Go to Europe. By P. O. Ripley, Ph.D., Department of Agriculture, Ottawa.

Mystery Islands in the Arctic. By W. K. W. Baldwin, M.B.E., M.A., National Museum of Canada, Ottawa.

North to the Midnight Sun. By Douglas Leechman, Ph.D., National Museum of Canada, Ottawa.

The assistance of the Boy Scouts, Wolf Cubs, and Commissionaires on Saturday mornings in keeping order among the large number of children who come to the lectures is greatly appreciated by the Lecture Committee. Particular acknowledgment is made of the assistance of the National Film Board in making their films available, also of the Ottawa Public Library in selecting and providing lists of books related to the subjects of the lectures for the use of any in the audiences who wish to do supplementary reading. Thanks are due also to the local press for the co-operation given in reporting the various lectures.

LECTURE HALL

Scientific and related organizations were granted the use of the Lecture Hall. Lectures on a wide variety of subjects were sponsored by these organizations. Among the organizations using the Hall were the Royal Astronomical Society, the Canadian Geographical Society, Ottawa Fish and Game Association, Scientific Film Society, Ottawa Field Naturalists Club.

PHOTOGRAPHS

Photographs to illustrate scientific publications, textbooks, magazine and newspaper articles, and for exhibition were selected from the large photographic collection taken by officers of the National Museum. Requests for these photographs were received from the United Kingdom, the United States, European countries, and Canada.

PUBLICATIONS

An increasing number of educational and scientific institutions found Museum publications of value and encouraged students and others to make full use of this material. Distribution of Museum publications was in excess of 30,000.

VISUAL AIDS

Considerable Museum material on anthropology, biology, and other phases of the natural history of Canada went to teachers, students, and other persons in all parts of Canada. This material is lent free of charge to educational institutions in Canada except for cost of transportation one way.

MACOUN FIELD CLUB

Mr. W. K. W. Baldwin reports on the Macoun Field Club and its activities as follows:

A project in natural history activities for children was launched by the National Museum in May, 1948. This was undertaken in co-operation

with the Ottawa Field-Naturalists' Club on a basis of joint sponsorship. The purpose of the project is to foster the natural interest of children in all wildlife and to guide them in the understanding and conservation of nature.

The project had its beginnings in meetings of interested persons to consider what had been done in this field and what could be done under existing circumstances. It was decided to start with a group of twenty children about twelve years of age. A committee was appointed by the sponsors to initiate a program based on the recommendations of the organizing committee. The project was named the Macoun Field Club, after Professor John Macoun, botanist and naturalist, who was active in the early days of both sponsoring institutions. Prospective members of the Club were then recruited from the boys and girls who attended the National Museum Saturday Morning Lectures and from the children of members of the Field-Naturalists' Club. In addition, some valuable members were recruited from boys interested in natural history at summer camps. Certain school teachers also encouraged their pupils to join, and these children have become some of the most constant and deeply interested members.

Three programs have been issued each year, one for each of the seasons: spring, autumn, and winter. In the spring the Club was taken on Saturday morning excursions to points of natural interest readily accessible by streetcar or on foot from the Museum. When the weather was bad, the Club met indoors in a basement room of the Museum equipped with suitable tables, chairs, and cupboards. Here the children reported on their observations and worked on their collections and notebooks.

Excursions were continued in the autumn until the beginning of the second series of the National Museum Saturday Morning Lectures. The Club attended the first performance of this series each Saturday in the Lecture Hall and then held indoor meetings in the special project room in the basement.

In the winter season the Club made a winter bird-hike and devoted most of their time to working over collections, observations, and notebooks, as well as attending the winter series of the Museum Saturday Morning Program. In addition, the Club invited specialists in various natural history and conservation subjects to give informal talks. These were well received and were followed by eager questions and spirited discussion.

During the first year the Club appeared in public on several occasions. The children put on two performances for the Museum Series in which they described their activities and displayed their collections. As a result of this performance they were asked to give a broadcast on the same theme for a local radio station. They assisted in another Museum program by wearing the Indian masks used in the preparation of the film "The Loon's Necklace." The Club put on two exhibitions of their collections, one at the annual dinner of the Field-Naturalists and the second at the National Museum for a special meeting held for sponsors, parents, and friends. This meeting celebrated the first birthday of the Club. Mrs. Mary Macoun Kennedy presented membership badges to the twenty children who had shown the greatest interest throughout the year. Mrs. Kennedy is a grand-daughter of John Macoun, whose name this Club commemorates.

The programs followed essentially the same pattern in the second year. In the light of experience gained in the first year, a few activities have been modified or replaced. In place of keeping large groups together during excursions, it has been found better to divide the party into smaller teams. Fewer talks and movies have been given to gain time for more work on notebooks, reports, specimens, and exhibits by the children themselves. A Club library, begun in the first year, has been less emphasized, because its use has been limited, and the children have been greatly aided by gifts of natural history books from their families and friends.

At the beginning of the autumn program an afternoon excursion was made to the New Lodge at Beattie Point upon the invitation of the Ottawa Field-Naturalists' Club. The Macoun Field Club was also invited to arrange and demonstrate an exhibit at the Youth Week Hobby Show at Lansdowne Park.

The membership of the Club is growing in both age and numbers. Following the plan proposed at the time of organization, an older group of high school age has been graduated from the beginners, so that there are now two groups of about twenty each.

Mr. L. R. Adair, a member of the Field-Naturalists Club, presented a collection of plants from the Ottawa area to the Macoun Field Club. This generous gift was much appreciated by the children and spurred them on to greater botanical activity.

The key to successful operation of such an enterprise quite evidently lies in proper leadership. Without enthusiastic leaders who have both adequate knowledge of natural history and the ability to deal with children, the whole experiment would fail. At the present stage it has been found best to have at least two adult leaders for the outdoor excursions, one to head the party and one to bring up the rear. In time, it is hoped to get leaders from the older members of the Macoun Field Club itself. These will look after about five groups of four younger members each.

On all field trips a simple objective is chosen. It has been found easier to manage unexpected developments by having a clear plan at the outset. If the idea of the excursion is too general, parties scatter too widely for good results. Furthermore, the boys and girls get greater enjoyment from the trip if they are of a natural age group. Too wide a difference in age produces too many interests, and the excursions lack focus. Treasure hunts and competitions for finding a list of natural objects have proved particularly successful features for the younger members. The giving of tests and proficiency badges has been carefully avoided. It is indeed impossible to measure the true interest of the children. It is further believed that actual harm results from such spurious rewards.

With the help of adult advisers the indoor meetings are managed by chairmen and committees elected from the children themselves. This, incidentally, has value in giving the children some responsibility and experience in leadership. The spirit of the meeting is highly informal. Children realize the distinction between the essentially formal education of school classrooms and the informal learning in this club. The two ways of learning are both necessary and should complement each other.

Again it was found best to separate the natural age groups. Although the age of the first recruits to the Club has tended to be lower, it seems to be around 12 years of age that interest in natural history is first firmly caught. Younger children generally pass through many interests too fleeting for useful encouragement in a club of this nature. However, if their instinctive interest in natural history is fostered at about 12 years of age, then there is a good chance that this will develop and continue to give them satisfaction for the rest of their lives. In some cases it is believed that this will develop into a life vocation which might well be found in museum work, technical or academic work in biology, geology, or anthropology, or field work in land and wildlife conservation. In most cases natural history will remain a lifelong hobby.

Procedure at the indoor meeting has been developed by trial and error. The 12-year-old group thoroughly enjoy reporting and discussing their observations. They are encouraged to make notebooks and scrapbooks from which they contribute to the Club's book. These children have the collectors' instinct well developed, and from this has grown their own "Museum" of exhibits.

The older group of high school age, while hesitant about reporting their personal observations, are keen to hear about all that is going on. They attend some of the Museum lectures as well as the Audubon Screen Tour series, sponsored by the Ottawa Field-Naturalists' Club, where a team of the Macoun Field Club serves as ushers. As they are old enough to go more deeply into their hobby, they have been encouraged to choose an area close to home where they are now engaged in making a more intensive study of the natural history. The area now selected is both convenient and interesting for them. Visits to this project area take the place of the scattered excursions of the younger group. Already impressive lists of plants and birds have been made by the more experienced members of the group.

The joint committee appointed by the sponsors to manage this program has consisted of three members: Miss M. W. Godwin of the staff of the Museum, Mr. Herbert Groh of the Council of the Ottawa Field-Naturalists' Club, and the Chairman, Mr. W. K. W. Baldwin, who is a member of both staff and Council. The committee has been assisted in field excursions by Mr. D. C. Maddox of the Ottawa Field-Naturalists' Club and Dr. H. J. Scoggan of the Museum staff. The Curator of the National Museum and the two successive Presidents of the Field-Naturalists' Club have taken a personal interest in this experiment. In addition, the committee wishes to acknowledge their debt to a wide circle of interested persons who have given their support to this work.

ARCHÆOLOGY

Field Work

Dr. Douglas Leechman was engaged in field work from May to September. He first visited Winnipeg, where a large bone implement, made from the fibula of an elephant, had been found. He examined the

site and was successful in collecting specimens which may possibly be associated with this find. He then proceeded to the central part of British Columbia in the vicinity of Stuart and Fraser Lakes. Ten or fifteen sites were examined, and a large collection of chipped stone implements was secured. Comparison of this material with that from other sites of the Western Plains is now being undertaken. From there he proceeded to the southern Yukon where he examined other sites of the culture first discovered by Frederic Johnson in 1944. At the northern end of Lake Bennett, several sites were examined on an old soil surface recently re-exposed by the migration of sand dunes which had previously covered them. These were well below a layer of volcanic ash, which is believed to have fallen about 500 A.D.

At Boundary Bay, about twenty miles south of Vancouver, B.C., Dr. Carl Borden, archæologist at the University of British Columbia, directed the excavation of a kitchen midden. The field party was made up of students from the University of British Columbia, the University of Washington, and the University of Toronto. Dr. Leechman spent ten days on this site. A 5-foot trench was cut through the midden which, at this point, was 75 feet wide and 12 feet deep. Its total length is approximately 500 yards. Thirteen burials were found, six of them juvenile. In the case of one, a child of about twelve, both hands had been removed just above the wrists before burial. About 380 artifacts, both chipped and ground stone tools, were found as well as artifacts of bone and shell. Preliminary impressions suggest that the stratification will reveal cultural sequences. Most of the artifacts and burials were found on the west side of the midden. It is hoped to continue work at this site in 1950.

From September 5 to 12, Dr. Leechman attended the Congrès des Americanistes in New York; on October 15, he attended the session of the Canadian Museums Association in Ottawa; from November 15 to 21, he was at the annual convention of the American Anthropological Association in New York.

Dr. Richard S. MacNeish, from June 22 to the end of August, was engaged in an archæological survey in the Northwest Territories. He examined three areas: east of Great Slave Lake, northeast of Lake Athabasca, and Mackenzie River from Fort Providence to Norman Wells. He travelled about nine thousand miles, found 40 sites, and collected about 200 artifacts, subsequent study of which showed that there are five distinct cultures in the first two areas investigated. The sites and artifacts found in the Mackenzie area show its importance and the necessity for future work there. During the last two weeks of November, he visited Buffalo, Ann Arbor, Toronto, and a number of collectors in southern Ontario, to supplement his information on Iroquois pottery.

Dr. Henry B. Collins, Jr., of the Smithsonian Institution, Washington, D.C., undertook the excavation of an Eskimo site at Resolute Bay on Cornwallis Island (latitude 75°, longitude 95°) where he found abundant Thule material. In the lower levels, animal material, such as mittens, boot soles, skin and gut, was well preserved. A type of lamp in which pottery sides were added to a limestone slab base was found. There was no trace of Dorset material.

Miss Catherine McClellan, assisted by Miss Dorothy Rainier, both of the University of California, continued the ethnological studies of the Interior Thlingit of the southern Yukon under the direction of Dr. Leechman. They worked at Teslin, Carcross, and Klukshu, and collected a large body of data, including photographs, and songs on a wire recorder. Emphasis was laid on social organization, material culture, the effect of the Thlingit on the interior Athabaskan people, and linguistic changes.

Mr. Thomas Lee, a student at the University of Michigan, undertook an archæological survey of the lower peninsula of Ontario. He was primarily interested in the pre-Iroquois horizons of that area. The materials collected from the surface and from test pits indicate the existence of pre-pottery sites and also sites very similar to those of the Point Peninsula culture of New York and, most important, a number of Owascoid sites, which appear to be directly ancestral to the prehistoric Iroquois (proto-Neutral-Erie-Huron) of that area.

Office Work

In the office, Dr. Leechman studied the material collected in the field and also that presented by various donors. He continued his work on the problem of the migration of man from Asia to America and on other aspects of Canadian prehistory. He examined and reported upon specimens sent in for identification, including skeletal material submitted by the Royal Canadian Mounted Police. He edited and wrote the commentary on two documentary films; the first, entitled "Moose Hide," showing Indian methods of smoking and tanning hides, as practised in southern Yukon; the second, on "Flint Chipping," showing the method of making the stone tools used by prehistoric man. Both of these he had photographed in the field during the summer. He assisted the National Film Board in the preparation of a film strip illustrating North American Indian masks. He was asked by the Canadian Board on Geographical Names to assist by commenting on the suitability of proposed place names of Indian origin.

Dr. MacNeish worked on the preparation of reports, including one written in co-operation with Dr. W. A. Ritchie, entitled "Pre-Iroquois Pottery Types" which appeared in *American Antiquity*, October, 1949; "Archæology of the Northeast" to be published in the Cole Memorial Volume; "Synopsis of the Archæological Sequence of Canyon del Diablo, Tamaulipas, Mexico" in *Revista Mexicana de Anthropologia*, in December, 1949; "Huron Pottery" in the bulletin of the Anthropological Association of Toronto, December, 1949. His extensive paper on "Iroquois Pottery Types" was finished except for revision and checking. A number of brief communications and progress reports were also prepared. Before writing the paper on "Iroquois Pottery Types," it was necessary to study archæological material from various sites in Ontario. The material collected in the Northwest Territories was studied, and a preliminary discussion of it was prepared. About 2,000 archæological specimens were catalogued, and preliminary plans for eight archæological exhibits were completed. He attended the Congrès des Americanistes in New York City and made plans for his field work in 1950.

Publications

The Dorset Eskimo Culture. By Douglas Leechman. Encyclopedia Arctica (In press).

The Bella Coola Indians (Review). By Douglas Leechman. Canadian Historical Review.

The Loon's Necklace. By Douglas Leechman. Fashion Digest, New York (In press).

Implement of Elephant Bone from Manitoba. By Douglas Leechman. American Antiquity (In press).

Pacific Northwest Coast Art (Review). By Douglas Leechman. Canadian Art (In press).

Pre-Iroquois Pottery Types. By Richard S. MacNeish (with W. A. Ritchie) American Antiquity, October, 1949.

Archæology of the Northeast. By Richard S. MacNeish. Cole Memorial Volume (In press).

A Synopsis of the Archæological Sequence of Canyon del Diablo, Tamaulipas, Mexico. By Richard S. MacNeish. Revista Mexicana de Anthropologia, December, 1949.

Huron Pottery. By Richard S. MacNeish. Bulletin of the Anthropological Association of Toronto, December, 1949.

Lectures

The Loon's Necklace. By Douglas Leechman. Arctic Associates, Montreal, April 21, 1949. Stoney Creek Reserve, Vanderhoof, B.C., June 11, 1949. Marine Biological Station, Friday Harbour, August 13, 1949.

Canada's First Immigrants. By Douglas Leechman. (CBO Radio Forum) June 4, 1949.

Archæology of Western Canada. By Douglas Leechman. Radio Talk, Edmonton, July 1, 1949.

Indians of the Northwest Coast. By Douglas Leechman. S.S. *Princess Louise*, July 31, 1949.

North American Indian Origins. By Douglas Leechman. Carleton College History Class, October 17, 1949.

Teaching Lessons on the Canadian Indian. By Douglas Leechman. School Teachers' Seminar, November 4, 1949.

Mammoth Bone Implement. By Douglas Leechman. American Anthropological Association, New York, November 18, 1949.

The Yukon Today. By Douglas Leechman. Ottawa Field-Naturalists' Club, December 6, 1949. Quebec Society for the Protection of Birds, Montreal, January 9, 1950. Museum of Fine Arts, Montreal, January 11, 1950. Ottawa Normal School, January 13, 1950.

Movement of Man into the New World. By Douglas Leechman. Anthropology Class, University of Toronto, March 17, 1950.

Instructional Films in Anthropology. By Douglas Leechman. Graduate Students and Faculty in Anthropology, University of Toronto, March 17, 1950.

Thule and Dorset Eskimo Cultures. By Douglas Leechman. Anthropology Graduates, University of Toronto, March 18, 1950.

First Men in the New World. By Douglas Leechman. Royal Canadian Institute, Toronto, March 18, 1950.

Mexican Archæology. By Richard S. MacNeish. Y.M.C.A. luncheon club, March 24, 1950.

Co-operation of Geologists and Archæologists. By Richard S. MacNeish. Logan Club, March 21, 1950.

Accessions

Mrs. Bailey: chipped stone implements from British Columbia.
John Blackwell: two chipped stone points from British Columbia.
H. S. Bostock: flaked stone fragment from the Yukon.
Miss E. E. Bradley: bone implements from British Columbia.
L. L. Brethour: stone axe from Ontario.
R. S. Collins: chipped stone implements from British Columbia.
C. M. Dent: stone gouge from Ontario.
Herbert Hargreaves: stone knife and celt from British Columbia.
J. A. Houston: goosefoot bag from Povungnituk.
Alfred Johnson: wooden chest and hat from British Columbia.
Frank Johnston: sample of native black paint from the Yukon.
Norval Kilgour: stone adze from Quebec.
Douglas Leechman: archæological collections from Manitoba, British Columbia, and the Yukon.
Miss Catharine McClellan: three scrapers from the Yukon.
T. H. Manning: Eskimo skeletal material from Smith Island.
J. Murphy: Prairie Indian pipe and club.
L. T. S. Norris-Elye: pottery and chipped points from Manitoba.
G. D. O'Brien: chipped stone knife from Alberta.
George Ogston: chipped points and scraper from British Columbia.
Russell Patterson: chipped stone knife from British Columbia.
T. B. Phillips: Eskimo sealskin boots from Attawaspiskat.
W. A. Ritchie: archæological collection from Ontario.
J. H. Sewell: collection of archæological specimens from British Columbia.
E. A. Trevor: chipped blade from the Yukon.
Mrs. R. Wilson: small ethnological collection.

ETHNOLOGY

Field Work

Marcel Rioux spent from July 10 to August 31 on the Grand River Six Nations Reserve studying the social structure of this Iroquois group; on this first trip he concentrated on the Handsome Lake religious group where the ancient culture has been better preserved than in others. Folk-lore and linguistic materials were also gathered, especially among the Cayugas and the Mohawks.

Miss Helen Creighton continued her studies in Nova Scotia along the southwestern coast, mainly Halifax County and the parts of Queens and Shelburne Counties settled from New England. In addition to many items of folk-lore, 165 folksongs were added to her collection from Nova Scotia, bringing the total to about 1,200. Of these, 23 are of the type known as English and Scottish popular ballads; 107 are lyric folksongs whose subject matter deals largely with the sea; 2 are German lullabies from Lunenburg County, so difficult to find now, because there are few people who remember the German of the early settlers; 27 are singing games, such as children still play and grown-ups recall from their past; 3 are rounds; and 3 are sea chanties. The recording of such material on permanent tapes has a double advantage. First, it preserves for all time these songs and ballads which are rapidly disappearing from our tradition and in the way they are traditionally sung, and secondly it enables the musicologist of the National Museum staff to set the music on paper of any that are required for some particular purpose.

Miss Carmen Roy continued her folk-lore field work in the Gaspé area; she visited many localities and obtained 331 folksongs, 23 folk tales, and abundant information on medicine, folk dances, superstitions, blason populaire, and local legends; she paid special attention to the Jersey group living in Paspebiac and its neighbourhood.

Messrs. Lacoucière and Savard worked in various regions: Gaspé, Beauce, Charlevoix, and Joliette counties; they collected 125 folk songs, 29 folk tales, and 44 legends and anecdotes.

Miss Doyon worked in Beauce and Levis counties; she collected information on 37 different topics including 810 descriptions and 31 drawings of specimens.

Office Work

During the winter months, Marcel Rioux continued to work on his Ile Verte materials and nearly completed the writing of a monograph which will consist in an analytical study of a contemporary peasant society. He also prepared a questionnaire on "Early Childhood Socialization Processes" which is to be used in the field by some Canadian social scientists. In December he participated in the "Panel on Indian Research." Besides guiding and instructing field workers who do not report to Ottawa, he classified and catalogued folk-lore materials collected in the field during the summer months.

Miss Josephine Hambleton, who joined the staff of the Museum in December, 1949, assisted in the preparation for publication of the field notes and photographs relating to Haida carving in argillite, which Marius Barbeau has taken during numerous visits to the Queen Charlotte Islands. She has also carried on research on Eskimo and other Canadian costumes.

Miss Margaret Sargent joined the staff of the Museum in April, 1949, in her capacity as musicologist. She has since been engaged in transferring Indian songs collected as far back as 1911 from early perishable wax cylinders to magnetic recording tapes. She has also transcribed 225 Huron-Wyandot songs, of which 82 will be used in a projected publication on "The Old-World Dragon and the Great Lakes and the St. Lawrence."

Publications

L'Évolution de l'anthropologie moderne. By Marcel Rioux. Notre Temps, novembre 1949.

Le département d'anthropologie du Musée National. CIAP, Paris. By Marcel Rioux. Avril 1949.

The Meaning and Function of Folk-lore in Ile Verte. By Marcel Rioux. National Museum of Canada, Bulletin 118, 1950.

El Siglo de Oro del Arte del Canada Francés. By Josephine Hambleton. Woodcarving in French Canada, in El Nacional, Caracas, Venezuela, December, 1949.

Un Arte Indo Canadiense—Haida Argillite Carvings. By Josephine Hambleton. El Nacional, Caracas, Venezuela, January, 1950.

Los Esquimales—Eskimo Folk-lore. By Josephine Hambleton. El Nacional, Caracas, Venezuela, February, 1950.

Lectures

Le concept d'Ethos en Anthropologie culturelle. By Marcel Rioux. ACFAS, Montréal, le 17 octobre 1949.

Le Musée National du Canada. By Marcel Rioux. CKCH, Hull, 14 mars 1949.

ZOOLOGY

Field Work

Field investigations of the birds and mammals of southwestern Yukon were made by W. Earl Godfrey, who was assisted by Colin L. Thacker of the Museum staff and by Ian V. F. Allen, Haney, B.C. Base Camps were maintained at Kluane Lake, June 25 to July 15; the Haines Road at Kathleen River, July 16 to August 5; and Carcross, August 6 to 23. Also, limited observations were made and some bird specimens taken on the British Columbia part of the Haines Road and the Alaska Highway. Altogether, 412 birds, 98 mammals, and 2 amphibians were collected, detailed notes were made, and habitat photographs and motion pictures were taken.

Austin W. Cameron, accompanied by J. Sherman Bleakney, Marshall H. Ronalds, and Lloyd A. Duncanson, collected mammal and bird specimens in southern and central Newfoundland during the period June 1 to August 20. Collections and observations were made at the following stations: Port-aux-Basques, Tompkins, South Brook, Humber Falls, and Salmonier (Avalon Peninsula). A small plant collection was also made, and motion and still photographs of animal habitats were obtained. A total of 48 native mammals and 163 birds, particularly desired for the National Collection, were secured.

Mr. Cameron also spent the period October 5 to 8 in Gaspé County, Quebec, where he examined the skull of a Greenland Bowhead whale (*Balaeana mysticetus*), unearthed at Ste. Anne des Monts. This specimen is of unusual biological interest, because it extends the known range of this species some 1,200 miles to the south.

A party composed of Charles O. Handley, Jr., representing the Smithsonian Institution, Washington, D.C., and Stuart D. MacDonald, National Museum of Canada, studied the birds and mammals of remote Prince Patrick Island, N.W.T., for their respective institutions in the period April 19 to October 12. Base camp was at the Mould Bay weather station. Mr. MacDonald's collection for the National Museum of Canada numbered 207 birds and 122 mammals. He also brought back notes, habitat photographs, a small collection of plants, some fossils, and animal parasites.

Mr. T. H. Manning, in charge of a Geographical Bureau expedition to Hudson Bay and Foxe Basin, collected birds, mammals, and zoological and other data for the National Museum.

Office Work

Clyde L. Patch devoted considerable time to supervision and instruction. Amphibians and reptiles were identified, inquiries regarding herpetology were replied to, and additional manuscript was prepared for a proposed publication on the herpetology of Canada. An illustrated paper on the Canadian beaver was prepared for museum publication. Six copies of a meteor were cast and coloured for the Dominion Observatory.

Birds and mammals were prepared for museum and loan purposes, and the construction of three mammal group models was started.

W. Earl Godfrey continued research on the taxonomy and distribution of the birds of Canada. He completed and submitted for publication a

359-page manuscript on the birds of western Saskatchewan and a 51-page report on the birds of southern Yukon Territory. A taxonomic study of the brown-headed chickadees was continued with study of additional material from critical localities, and the results are almost complete. He spent the period June 5 to September 6 in the field, mostly in southwestern Yukon. Routine duties included the ornithology correspondence and supervision of work on the systematic bird collection and distribution files.

Austin W. Cameron continued research on the taxonomy, distribution, and ecological relationships of Canadian mammals. Laboratory research included taxonomic studies of the chipmunk genus *Tamias* and of recently acquired mammal material from northern Quebec and southern central Saskatchewan. The Saskatchewan study has been brought almost to completion, but additional material is required from a number of critical localities. Two papers, "The Mammals of the Lake Mistassini and Lake Albanel Region, Quebec" and "A New Chipmunk from Ontario and Quebec", have been prepared and submitted for publication. A series of popular leaflets dealing with mammals represented in the habitat groups in the Museum exhibition halls are in course of preparation.

Claude E. Johnson completed the fox group background and the installation of accessories. He made preliminary designs for murals to be painted on the panels above the glass of the large mammal groups and began work on the mural over the glass of the bison group. Miss Phyllis M. Hurlbert devoted much of her time to bibliographical work on the ornithology and mammalogy literature files and continued work on species distribution map, abstracting distributional information contained in the 1946 literature. She also maintained the accession records for the Biological Division. Colin L. Thacker prepared material for study and for the School Loan collections, completed a crossbill nesting branch for display, catalogued recently acquired birds, and assisted on various other projects. Stuart D. MacDonald prepared specimens for the study and the School Loan collections, catalogued mammal accessions, and assisted on various other activities. George Blanchard prepared osteological specimens and, in addition to finishing recent accessories, worked on the processing of several years accumulation of material.

Publications

Further Northern Records of the Wood-frog. By Clyde L. Patch. Copeia, 1949, No. 3, September 15.

Birds of Lake Mistassini and Lake Albanel, Quebec. By W. Earl Godfrey. National Museum of Canada, Bull. 114, Biol. Ser. 38, 1949, pp. 1-43, 6 plates, 1 map.

European Starling Reaches the Pacific Coast. By W. Earl Godfrey. Canadian Field-Naturalist, 1949, vol. 63, No. 4, p. 165.

Zoological Investigations in Western Saskatchewan. By W. Earl Godfrey. Annual Report of the National Museum for the Fiscal Year 1948-1949, National Museum of Canada, Bull. 118, 1950, pp. 93-94.

Four Reviews of Current Literature. By W. Earl Godfrey. Canadian Field-Naturalist, 1949, vol. 63, No. 2, p. 92; No. 3, p. 118, and No. 6, p. 241.

Two Reviews of Current Literature. By W. Earl Godfrey. Bird-Banding, 1950, vol. 21, pp. 26-27, 33.

The Mammals of the Lake St. John Region, Quebec. By Austin W. Cameron and Phillip A. Orkin, Annual Report of the National Museum for the Fiscal Year, 1948-1949, National Museum of Canada, Bull. 118, 1950, pp. 95-108.

Lectures

Turtles. By Clyde L. Patch. Lady Sherwood Cadets, St. John's Hall, Ottawa, November 7.

Snakes, Frogs, and Turtles. By Clyde L. Patch. Museum Lecture Series, 9.45 and 11.00 a.m., January 28.

Backstage in a Museum. By Clyde L. Patch. Home Arts Club, Y.W.C.A., Ottawa, March 8.

The National Museum's Bird Collection. By W. Earl Godfrey. The Ornithology Section of the Ottawa Field-Naturalists' Club, Museum Building, December 3.

Summer in the Yukon. By W. Earl Godfrey. Ornithology Section of the Ottawa Field-Naturalists' Club, February 3.

Newfoundland Wildlife. By Austin W. Cameron. Ottawa Field-Naturalists' Club, January 19.

Accessions

BIRDS

By Gift:

Ball, Mrs. George, Tuscaloosa, Alabama: 13 bird skins from Ontario and New York State.
Banfield, A. W. F., Dominion Wildlife Service, Ottawa, Ont.: 2 American pipits and 3 Lapland longspurs.
Bennett, C. H., Ottawa, Ont.: 2 robins.
Blakely, David J., Ottawa, Ont.: 1 red-winged blackbird, 1 bronzed grackle, 1 catbird.
Bourguignon, A. E., Ottawa, Ont.: 1 mourning warbler, 1 Lapland longspur, 1 knot, 1 white-rumped sand-piper, 1 ruby-crowned kinglet, 1 black-bellied plover, 2 greater yellow-legs, 2 snow buntings.
Boyer, George F., Dominion Wildlife Service, Sackville, N.B.: 1 swamp sparrow, 1 Hudsonian chickadee.
Brown, H. M., Ottawa, Ont.: 1 tree swallow.
Caldwell, Miss May, Ottawa, Ont.: 1 purple martin.
Cameron, John W., Port Hood, N.S.: 1 dovekie.
Childers, Walter, Ottawa, Ont.: 1 Cape May Warbler.
Clarke, Dr. C. H. D., Ontario Department of Lands and Forests, Toronto, Ont.: 23 horned grebes.
Clarke, Ross, Ottawa, Ont.: 1 great horned owl.
Curtis, M. W., Ottawa, Ont.: 1 robin.
Dominion Wildlife Service, Ottawa, Ont.: 1 whooping crane.
Factor, J. M., Ottawa, Ont.: 1 weaver finch.
Findlay, D. D., Carleton Place, Ont.: 1 upland plover.
Freda, Nick, Ottawa, Ont.: 1 red-tailed hawk.
Geographical Bureau Expedition 1949 to Foxe Basin, collected by T. H. Manning and A. H. Macpherson: 356 birds.
Gilliard, E. Thomas, American Museum of Natural History, New York: 80 bones of the great auk from Funk Island, Newfoundland.
Hohn, Dr. E. O., Edmonton, Alberta: 13 bird skins, 9 skulls, 4 bottles of bird stomachs.
Johnson, Giffard, Ottawa, Ont.: European partridge (head only).
Kavanagh, Miss Sheila, Ottawa, Ont.: 1 yellow-bellied sapsucker.
Kyer, Edouard, Ottawa, Ont.: 1 nighthawk.
Lewis, Dr. Harrison F., Dominion Wildlife Service, Ottawa, Ont.: 1 trumpeter swan egg, 6 pileated woodpeckers, 1 flicker, 1 hairy woodpecker, 1 golden plover, 1 varied thrush, 1 bluebird, 1 common tern, 1 golden-eye, 3 scaups, 2 loons, 86 parts of birds, mostly gulls.
MacDonald, Miss Elva P., Bayhead, N.S.: 1 red-winged blackbird.
MacFarlane, W. J., Aylmer, P.Q.: 1 ruby-throated hummingbird.
MacLennan, Fred, Sheldon Lake, Yukon: 1 black brant.
Manning, T. H., Ottawa, Ont.: 1 great blue heron, 1 meadowlark.
McIntyre, G. A., Mayo, Yukon: 1 yellow-bellied sapsucker.
Melburn, Miss M. E., Ottawa, Ont.: 1 hairy woodpecker, 1 saw-whet owl.
Munro, J. A., Dominion Wildlife Service, Okanagan Landing, B.C., 2 trumpeter swans, skin and sternum.

Ommanney, G. G., Hudson Heights, P.Q.: 1 evening grosbeak, 1 ruffed grouse, 1 old-squaw, 1 black-capped chickadee, 1 olive-backed thrush, 1 American merganser.
Orkin, Phillip A., Ottawa, Ont.: 1 red-winged blackbird, 2 bronzed grackles.
Pauze, Jean Baptiste, Beauharnois, P.Q.: 1 evening grosbeak.
Porsild, A. E., Ottawa, Ont.: 1 horned lark, 1 gyrfalcon, 1 yellow-billed loon, 1 sanderling (wing, head, and foot) from Banks Island, N.W.T.
Rausch, Dr. Robert, Anchorage, Alaska: 1 Hudsonian chickadee.
Robinson, Wayne, Ontario Department of Lands and Forests, Ottawa, Ont.: 1 pied-billed grebe.
Ross, Miss Verna, Ottawa, Ont.: 1 black and white warbler.
Savile, Mrs. D. B. O., Ottawa, Ont.: 1 white-throated sparrow.
Scoggan, Dr. H. J., and N. Neufeld, Ottawa, Ont.: 25 birds from central Manitoba.
Scott, D. M., St. Andrews, N.B.: 1 gull.
Smith, W. John, Ottawa, Ont.: 1 pied-billed grebe, 1 evening grosbeak, 1 Cooper's hawk.
Stewart, Ronald, Ottawa, Ont.: 1 goldfinch.
Stoneman, Pat., Ottawa, Ont.: 1 tree swallow.
Tuck, Leslie M., Dominion Wildlife Service, St. John's, Newfoundland: 1 Virginia rail.
Tufts, R. W., Wolfville, N.S.: 1 white-fronted goose (head, wing, and leg only); old-squaw (head only); 3 dovekies, 1 mourning dove, 2 purple finches, 1 Brunnich murre.
Tuttle, G. B., Ottawa, Ont.: 1 redstart.

Museum Expedition:

Godfrey, W. Earl, Colin L. Thacker, Ian V. F. Allen, Museum expedition to southwestern Yukon: 412 birds.
Cameron, Austin W., J. Sherman Bleakney, Marshall H. Ronalds, Lloyd A. Duncanson, Museum Expedition to Newfoundland: 163 birds.
MacDonald, Stuart D., Expedition to Prince Patrick Island, N.W.T., 207 birds.

By Members of Staff:

Cameron, A. W., Ottawa, Ont.: 1 song sparrow.
Godfrey, W. Earl, Ottawa, Ont.: 1 brown creeper, 1 black-capped chickadee.
Hurlbert, Miss Phyllis M., Ottawa, Ont.: 1 veery.
Johnson, Claude E., Ottawa, Ont.: 1 marsh hawk.
MacDonald, Stuart D., Ottawa, Ont.: 1 yellow-billed cuckoo, 1 red-eyed towhee, 13 pine grosbeaks, 4 blue jays, 1 ruffed grouse.
Patch, Clyde L., Ottawa, Ont.: 2 robins, 1 song sparrow.

Amphibians and Reptiles

By Gift:

Beckel, W. E., Goose Bay, Labrador: 1
Blanchard, Raoul, Ottawa, Ont.: 1
Cooper, Rudy, Innisville, Ont.: 1
East, A., Huntsville, Ont.: 1
Hughes, Mrs. L. M., Fort Coulonge, Que.: 1
Lawrence, Mrs. Louise de K., Rutherglen, Ont.: 1
Law, C. E., Fort Smith, N.W.T.: 3
Timonin, M. I., Farrell's Lake, Que.: 29

By Members of Staff:

Allen, Ian V. F., Yukon: 1
Godfrey, W. Earl, Haines Road, B.C.: 1
Johnson, C. E., Danford Lake, Que.: 21

Mammals

By Gift:

Ball, Mrs. George, Tuscaloosa, Alabama: 11 small mammals, 4 skulls, from Ontario and New York State.
Banfield, A. W. F., Dominion Wildlife Service, Ottawa, Ont.: 11 fox skulls, 1 caribou skull and skin, 1 wolf skull.
Boyer, George F., Dominion Wildlife Service, Sackville, N.B.: 3 mammals.
Cole, Miss Matilda, Point Fortune, Que.: 1 red bat.

Chambers, Rupert, Mile 1056, Alaska Highway, Yukon: 1 wolverine skin and skull.
Dempster, G. G. S., Jasper National Park, Jasper, Alberta: wolf, 6 skulls; cougar, 1 skin, 2 skulls; fox, 1 skin, 1 skull; marten, 1 skin.
Fleming, James N. P., Riverhead, Long Island, N.Y.: 20 mammals.
Fuller, W. A., Dominion Wildlife Service, Wood Buffalo Park, N.W.T.: wolf, 8 skulls; wolf, 7 skins.
Geographical Bureau Expedition 1949 to Foxe Basin, collected by T. H. Manning and A. H. Macpherson: 240 mammals.
Goodhue, Clesson, Ottawa, Ont.: 1 big brown bat.
Groh, Herbert, Ottawa, Ont.: 1 star-nosed mole.
Hart, Dr. J. S., Ottawa, Ont.: 1 white-footed mouse, 2 lemmings.
Holland, G. P., Ottawa, Ont.: 97 skins and skulls from Manitoba, Northwest Territories, and Newfoundland.
Jones, Henry, Cloyne, Ont.: 11 snowshoe hare skulls.
Lang, H. K., Aklavik, N.W.T.: 2 porcupines, 14 small mammals.
Macpherson, Andrew H., Ottawa, Ont.: 1 flying squirrel.
Neilson, James, Ottawa, Ont.: 1 woodchuck, melanistic.
Palæontology, Division of, Ottawa, Ont.: 2 northern sea-lion skulls.
Pickering, L. R., Whitehorse, Yukon: 1 pickled small mammal.
Porsild, A. E., Ottawa, Ont.: 1 lemming from Banks Island, N.W.T.
Ronalds, M. H., Bathurst, N.B.: 6 shrews, 1 woodchuck.
Savile, Dr. D. B. O., Ottawa, Ont.: 19 mammals, skins and skulls; 1 polar bear skull; 1 red squirrel.
Scoggan, Dr. H. J., Ottawa, Ont.: 40 mammals from central Manitoba.
Strong, B.I.M., National Parks Bureau, Prince Albert National Park, Saskatchewan: 1 timber wolf, 5 wolves; 1 coyote, 2 foxes.
Viret, Prof. J., Lyon, France: 7 mammals.

By Purchase:

Crawford, T., Hudson's Bay Co., Payne Bay, P.Q.: 4 caribou skulls.
Duncanson, Lloyd, Gaspereau, N.S.: 3 raccoons, skins and skulls.
Harrington, Richard, Beechy Lake, Bathurst Inlet, N.W.T.: 1 albino caribou skin prepared by an Indian.
MacDonald, Roderick, Bayhead, N.S.: 1 Nova Scotia wildcat, skin and skull.

Museum Expedition:

Cameron, Austin W., J. Sherman Bleakney, Marshall H. Ronalds, Lloyd A. Duncanson, Museum Expedition to Newfoundland: 48 mammals.
Godfrey, W. Earl, Colin L. Thacker, Ian V. F. Allen, Museum Expedition to southwestern Yukon: 98 mammals.
MacDonald, Stuart D., Expedition to Prince Patrick Island, N.W.T.: 122 mammals.

By Members of Staff:

Blanchard, George, Ottawa, Ont.: 1 big brown bat.
Cameron, Austin W., Ottawa, Ont.: 6 bats.
Johnson, Claude E., Ottawa Ont.: 1 hare, 1 flying squirrel, 2 chipmunks, 2 white-footed mice, 1 red-backed mouse from Danford Lake, Que.
MacDonald, Stuart D., Ottawa, Ont.: 3 raccoons, 2 skunks from Bayhead, N.S., 1 collared lemming, Ottawa.
Patch, Clyde L., Ottawa, Ont.: 8 mammals, 5 meadow mice, 4 short-tailed shrews from Renfrew County, Ontario.
Thacker, Colin L., Ottawa, Ont.: 1 white-footed mouse.

NATIONAL HERBARIUM

Field Work

A. E. Porsild, Chief Botanist, as member of a party jointly sponsored by the Arctic Institute of North America, the Geographical Bureau, and the National Museum, during July and August carried out botanical reconnaissances on Great Bear Lake and on Victoria and Banks Islands, N.W.T. The party, besides Mr. Porsild, included Dr. A. L. Washburn,

Executive Director of the Arctic Institute of North America, Mrs. A. L. Washburn, and Mr. J. L. Jenness of the Geographical Bureau, and operated from an advance base at Holman Island Post, Victoria Island, using a chartered aircraft on floats. The season of 1949 was unusually late, and aircraft on floats were unable to land on Victoria Island until the end of July; on the 23rd of August sharp frost and new snow stopped the collection of plants. Although landings were made in a number of places in Banks and Victoria Island, in only one or two did time permit long enough stops for detailed botanical collecting. Nevertheless, at the end of the short season the total number of flowering plants and ferns known to occur on Banks Island had been increased from 65 to 174 and that of Victoria Island from 106 to 201 species. The collections of plant specimens were supplemented by kodachromes, black and white photographs illustrating floristic and physiographic features, and by copious notes on matters related to the flora, fauna, and physiography of the islands.

H. J. Scoggan led a field party during the months of June, July, and August, in a botanical survey of the water route extending along the Nelson, Echimamish, and Hayes Rivers, from Norway House off the north end of Lake Winnipeg to York Factory on Hudson Bay. The return trip was made by ascending Nelson River to Limestone Rapids, where the party entrained for Wekusko. The last part of the season was spent in the area of Wekusko Lake and Tramping Lake. Collections of cryptogams and vascular plants, numbering 1,859, were made, enough material being collected in each case, as far as possible, to make up six herbarium mounts. In general, collections were made to illustrate ecological habitats, and photographs were taken to show general topography and vegetation types. A collection of birds and small mammals was turned over to the Zoological Division for study and identification.

W. K. W. Baldwin took part in an expedition to Hudson Bay and Foxe Basin, led by T. H. Manning and sponsored by the Geographical Bureau. Leaving Ottawa on June 11, he joined the expedition which sailed from Moosonee in the *Nauja*, a 50-foot boat built especially for the expedition. In addition to 650 collections of flowering plants and ferns representing about 370 species and totalling 2,700 herbarium mounts, Mr. Baldwin made a collection of crustaceous lichens, arctic seeds, and insects, and made numerous photographs of both botanical and geographical interest. He returned to Ottawa on October 11.

Office Work

During the year Mr. Porsild completed a final revision of the typescript of his "Botany of Southeastern Yukon," which had been submitted for publication a year ago but not yet printed. He prepared for publication a 50-page revision of the Genus *Antennaria* in Northwestern Canada and a shorter paper describing five new *Compositae* from Yukon. He spent considerable time on the preparation of an annotated catalogue of the flowering plants and ferns of Keewatin and Mackenzie Districts and also prepared preliminary reports on his botanical investigation of Banks and Victoria Islands, edited and checked four reports on forest botanical field work carried out in Ungava and Hudson Bay in 1948 and 1949 by Dr. I. Hustich of Helsingfors, Finland, and wrote several book reviews and

short articles. He named a total of 5,834 plants, of which 863 were submitted for identification and reports by other government departments or by Canadian and foreign universities and botanical institutions. He checked 8,355 mounted specimens before insertion in the National Herbarium and selected 6,505 duplicate specimens for distribution to other herbaria on exchanges.

H. J. Scoggan prepared for publication a 19-page report on the 1948 botanical survey of the Norway House–Cross Lake and northern Lake Winnipegosis areas of central Manitoba. He checked the galley and page proofs of his flora of the Gaspe Peninsula, Que. (399 pages, 1 map, 8 plates). A card index of about 3,000 cards was assembled to serve as the framework for a proposed flora of Manitoba. In this have been listed, with relative data, all Manitoba specimens in the National Herbarium, and in the herbaria of McGill University, the University of Montreal, and the Oka Agricultural College. Also listed are pertinent citations in various botanical periodicals and monographs. An index of about 800 cards containing references to the botanical literature was also assembled. He named the 1,721 vascular plants collected during the summer, arranged them for mounting and exchange, and drew up plans for the 1950 field season in northern Manitoba. He also named a collection of plants made by M. O. Malte in 1926 in New Brunswick and Prince Edward Island, comprising 905 numbers, as well as smaller collections made by Malte in Ontario, Alberta, and British Columbia. Other collections named were: I. Hustich, 110 numbers from Knob Lake, Labrador; W. Krivda, 125 numbers from The Pas, Manitoba; P. H. du Boulay, 25 numbers from Ontario and Manitoba; R. Nolet, 14 numbers from Ontario. The period November 7 to 19 was spent in Montreal making card index entries of Manitoba plants in the Herbaria of McGill University, the University of Montreal, and the Oka Agricultural College. He brought back 748 sheets of plants for critical study.

W. K. W. Baldwin prepared a summary report on the botanical work of the Foxe Basin Expedition for publication in the Annual Report of the National Museum and spent considerable time arranging the naming of seeds, lichens, and insects, as well as on 250 photographs for the records of the Geographical Bureau and members of the expedition, and assisted in editing a motion picture film of the expedition made by D. B. Coombs. He also prepared lists and notes from the 1947 expedition to James and Hudson Bay for the use of Dr. I. Hustich and for Mr. J. Kucyniak. He conducted the spring, autumn, and winter programs of the Macoun Field Club involving 40 meetings and excursions and wrote an account for publication of the organization and development of this experiment. He served on staff side and joint councils of the Branch as well as on the Departmental Councils of Mines, Forests and Scientific Services. He is a member of the Museum Lecture Committee and managed Boy Scout ushering and part of arrangements of 14 Saturday Morning Children's lecture programs. During the year he was responsible for the filing of mounted specimens in the Herbarium and for the selection of plant material requested on loan by other botanical institutions.

Miss H. Harkness, Herbarium Technician, was responsible for the mounting, labelling, cataloguing, and general care of specimens in the Herbarium as well as for the loan and exchange service, and in addition

mounted 3,167 plant specimens for insertion. During the year an exact count of mounted specimens in the Herbarium was commenced whereby serial numbers were stamped on each herbarium mount for the purpose of permanent identification and ready reference. At the same time a permanent card index was prepared of all families and genera for the purpose of recording the number of specimens contained in each of these groups. By the end of the year 153,859 mounted sheets had been counted, numbered, and indexed.

Miss Barbara Schwartz, Museum Assistant, inserted three issues of the Gray Herbarium Index, mounted 3,080 plant specimens, and worked with Miss Harkness on the numbering and indexing of the permanent collection and in other ways assisted in the care of the herbarium.

The following articles were published by the staff of the National Herbarium during the year:

A new *Antennaria* from Northern Ungava. By A. E. Porsild, Canadian Field-Naturalist, 63: 80-81 (1949).

Dowingia laeta Greene and *Megalodonta Beckii* (Torr.) Greene from British Columbia. By A. E. Porsild, Canadian Field-Naturalist, 63: 116 (1949).

Report on Health conditions in Greenland (Review of Danish Official Report). By A. E. Porsild, Arctic Circular 2: 53-55 (1949).

The Genus *Antennaria* in Northwestern Canada. By A. E. Porsild, Canadian Field-Naturalist, 64: 1-25 (1950).

Five new *Compositae* from Yukon-Alaska. By A. E. Porsild, Canadian Field-Naturalist, 64: 43-45 (1950).

A Biological Exploration of Banks and Victoria Islands. By A. E. Porsild, Arctic Circular 3: 1-9 (1950).

Families of Flowering Plants. By H. J. Scoggan. Canadian Nature, May-June: 86-88 (1949); Sept.-Oct.: 114-116 (1949).

Chestnuts. By H. J. Scoggan. Canadian Nature, Sept.-Oct.: 104 (1949).

Botanical Investigations in Central Manitoba. By H. J. Scoggan. National Museum of Canada Bulletin No. 118, 84-92 (1950).

Botanical Investigations on the East Coast of James and Hudson Bays. By W. K. W. Baldwin. National Museum of Canada Bulletin No. 113, 31-32 (1949).

Return of the "Nauja." By W. K. W. Baldwin. Domar, December, 26-28 (1949).

Lectures

Canada's Reindeer. By A. E. Porsild, Devonshire School, February 1, 1950, at Ottawa.

Plant life in the Arctic. By A. E. Porsild. Arctic Circle, Ottawa, February 9, 1950.

The Flora of the Gaspe Peninsula. By H. J. Scoggan. Province of Quebec Society for the Protection of Birds, February 13, at Montreal.

Expedition to East Coast of James and Hudson Bays. By W. K. W. Baldwin. Trinity College School, Port Hope, May 18, 1949.

Accessions, Loans, and Exchanges

During the year, 2,304 herbarium specimens were received by exchange, 683 by donation, and approximately 14,295 specimens resulted from field work by members of the National Herbarium staff. Specimens numbering 973 were loaned to, and 924 specimens were borrowed from, other botanical institutions. Duplicate specimens numbering 9,501 were distributed to

other herbaria in Canada and abroad, in continuation of exchanges. Specimens numbering 8,355 were mounted and inserted in the herbarium, bringing the total of numbered specimens in the National collection to 206,700.

Among the notable accessions is a complete set, numbering 1,617 beautifully prepared specimens of G. Samuelsson: Plantæ Sueciæ Exsiccatæ, received by exchange from the Swedish National Museum, Stockholm; and by donation, a collection, numbering about 2,000 specimens, of rare and critical Greenland plants collected by A. E. Porsild during the years 1940 to 1943 when, on loan to the Department of External Affairs, he was stationed in Greenland as Canadian Consul.

The National Museum gratefully acknowledges the donations of the following specimens and collections:

University of Michigan, Ann Arbor, Mich.: plants from West Greenland, 84.
A. J. Breitung, Ottawa: plants from Petawawa, Ont., 139.
I. Hustich, Helsingfors, Finland: plants from Petawawa, Ont., 163.
F/O. P. Lawson, Ottawa: plants fron northern Keewatin District, 119.
W. C. McCalla, Calgary, Alta.: plants from Alberta, 44.
Arctic Institute of North America, Montreal: plants from Ellef Ringes Is., N.W.T., 10.
Geo. Turner, Ft. Saskatchewan, Alta.: plants from Alberta, 36.
J. A. Munro, Okanagan Landing, B.C.; aquatic plants from British Columbia, 16.
Mrs. J. R. Woolgar, Yellowknife, N.W.T.: plants from Keith Peninsula, Slave Lake, 6.
H. S. Bostock, Ottawa, Ont.: plant from Yukon, 1.
M. Barbeau, Ottawa, Ont.: native tobacco plant from Ontario, 1.
Rev. E. Lepage, Rimouski, Que.: plants from Alaska, 13.
L. Jordal, Ann Arbor, Mich.: plants from Alaska, 7.
Hoyes Lloyd, Ottawa, Ont.: red spruce from Blue Sea Lake, Que., 1.
Austin Cameron, Ottawa, Ont.: plants from Newfoundland, 16.
Arthur Kellett, Ottawa, Ont.: cultivated species of Sedum, 3.
A. E. Porsild, Ottawa, Ont.: a collection of rare and critical plants from Greenland, 2,000.

Visitors

During the year some 150 visitors from Canada and from abroad visited the National Herbarium for shorter or longer periods for the purpose of examining specimens or for consultation on technical matters with members of the staff.

VERTEBRATE PALÆONTOLOGY

C. M. Sternberg supervised the work of the section and reported on vertebrate fossils sent in for identification. He continued his study of the vertebrate collections, with special emphasis on the three fine skeletons of small primitive horned-dinosaur, *Leptoceratops*. The description of this interesting genus was prepared for publication.

J. Skillen completed the preparation of the under side of the two small skeletons of *Leptoceratops*, made casts of this side, then set them in plaster, turned them over, and prepared the upper side for exhibition and study. This preparation is nearly complete.

H. L. Shearman assisted in general work and prepared the vertebræ and ribs of the third skeleton of *Leptoceratops*. These bones were freed from the rock for study.

A panel mount of a hooded duck-billed dinosaur has been finished and will be sent to the University of British Columbia as a loan. Dr. W. E. Swinton, Keeper of the British Museum (Natural History), spent a few days examining the dinosaur collection.

Lectures

Canadian Dinosaurs. By C. M. Sternberg, Nepean High School, Science Club, April 20, 1949.

The Age of Amphibians and Reptiles, *in* Prehistoric Canada Series. By C. M. Sternberg, W. A. Bell, F. H. McLearn, and E. L. Usher. Interviewed by Percy Newman, Radio Station CBO, Ottawa, June 18, 1949.

Accessions

Premolar tooth of mammoth from northwest tip of Yukon. Collected by Dr. L. Washburn.

Part of jaw of fossil lizard, *Chamops* cf. *segnis* Marsh. Presented by Mr. R. Cochrane of Grande Prairie, Alberta.

Cast of the type of *Hyaenognathus mattewi*, a Pleistocene dog. Presented by Dr. C. W. Hibbard, University of Michigan.

AN ARCHÆOLOGICAL RECONNAISSANCE IN THE NORTHWEST TERRITORIES

By Richard S. MacNeish

The summer of 1949 inaugurated archæological work in the Northwest Territories. One of the basic reasons for this preliminary endeavour in this region was to discover the cultural complexes and the sequences of cultural complexes of the Great Bear, Great Slave, Mackenzie River, and Lake Athabasca environs. As this area was free of glacial ice relatively soon after the end of the Pleistocene and as it occupies a central region along an often postulated route of man into America, it was hoped that archæological knowledge of this area would shed light on the problem of the migration of peoples and diffusion of culture from Asia to America.

Preliminary to intensive archæological researches in any previously unexplored territory, it is necessary to undertake an archæological survey. One of the primary purposes of any reconnaissance is to find the sites best suited for excavation and to delineate areas that warrant further intensive surveying. A preliminary survey may indicate the range of variation of the cultural material in the area, allow for a preliminary definition of the archæological complexes of the region by comparison of the artifacts from the various sites, and indicate a probable sequence of the cultural complexes by comparisons with the cultural sequences of surrounding areas, by seriations of artifacts from the sites, or by correlation of the artifact complexes with geological phenomena. In the following pages I shall describe the locations of the sites found, the artifacts found on each site, the relative merits for excavation of the various sites, and the areas where more intensive surveying is necessary. Also, by analysis and comparison of the materials from the various sites, I shall endeavour to describe some of the artifact complexes of the region and delineate in a preliminary way the sequence of these cultural complexes.

As a definition of the area explored, I shall briefly review my journey in the Northwest Territories. On June 22, I left Ottawa for Edmonton, stopping briefly at Winnipeg and Saskatoon in a futile attempt to obtain archæological information concerning the regions to the north. After a short stop in Edmonton I was flown to Yellowknife, Northwest Territories, arriving on the 27th of June. For ten days in Yellowknife, I discussed with various authorities on the northern country the actual and possible locations of sites, the general plan of procedure, the equipment necessary, and the many other details necessary for exploring. From these discussions a general agenda for the survey was made. First, I would go to the Mackenzie region, since ice was still formidable in much of the area around Great Bear and Great Slave Lakes; then to the Great Bear and Great Slave area; and finally to Lake Athabasca, as the weather stayed better longer in this more southerly region. On July 6, I went to Fort Providence at the headwaters of Mackenzie River and from the 7th to the 19th travelled by canoe, surveying, with my guide, the river shores from Fort Providence to Norman Wells. Then I returned to Yellowknife via Edmonton on the 23rd of July. On the 25th of July, my guide, Mr. Sam Otto, and I were flown out into the barren lands east of Great Slave Lake. We briefly

stopped at Aylmer Lake, Musk Ox Lake, and Artillery Lake. However, from July 26 to August 2, we intensively surveyed the area from the north end of Artillery Lake to Clinton Golden Lake, on foot and by canoe. On the 2nd of August, we returned to Yellowknife via Fort Reliance. On August 4, a visit was made to Yellowknife Hydro-Electric plant. On August 6, in company with a small party, a survey was made of parts of MacKay Lake, Courageous Lake, and Lac de Gras; on the following day Contwayta Lake was visited, and on the 8th, brief stops were made at Point and Providence Lakes in the Coppermine River drainages. On my last day in Yellowknife, there was an opportunity to make a brief reconnaissance at Indin Lake and at Taltheilei Narrows in the east arm of Great Slave Lake. On August 11, my theatre of operations was moved south to Fort Smith, and from the 12th to the 15th the area between Fort Fitzgerald and Little Buffalo River was surveyed. On August 16 a site was found at Hill Island Lake and at Beaverlodge Lake Portage on Lake Athabasca. August 17, 18, and 19 were spent reconnoitring the region around Goldfields on Lake Athabasca, and August 20 and 23 were spent at Fond du Lac. During the final days, August 25 to 27, a survey was made around Stoney Rapids and the area immediately east of Lake Athabasca. On August 28, I left Stoney Rapids for Prince Albert, Saskatchewan, stopping briefly at Black Lake and Lac la Ronge. From Prince Albert, I returned to Ottawa. During the survey, about 9,000 miles were covered, forty sites discovered, and 225 artifacts were collected.

THE SITES

Site 1. Site 1 (in the field notes called N.W.T.–1) was discovered during excavations for buildings for the Giant Mine at Yellowknife by Sam Otto. He discovered one small contracting-stemmed projectile point on a recent (low) beach, and later I discovered a part of a small corner-notched point near the boat dock. The area is now disturbed and covered by buildings, and excavation or further survey does not seem feasible.

Site 2. Site 2 was found by Sam Otto at his out-camp on the northwest corner of Aylmer Lake. This site appears to be a high terrace beach, probably belonging to the 700-foot shore of the glacial Great Slave Lake. One large incipient-stemmed projectile point, made from shale, was collected. Further inspection of this site would be profitable.

Site 3. Flint chips were found in a garden in the southeast corner of the Indian village located just south of the junction of J. Marie Creek and Mackenzie River. The site is not impressive or worthy of more intensive investigation.

Site 4. Located on the high terrace on the northeastern bank of the junction of Rabbitskin River and Mackenzie River. Flint chips were found by V. Lafferty and MacNeish. It is not impressive.

Site 5. This site is in reality probably a dozen or more sites. Just below and a little north of Dr. Truesdale's house at Fort Simpson, in the lower terrace, it is possible to see eight superimposed hearths in a steep bank cut by Mackenzie River. Further examination of the bank revealed other hearths, some of them associated with the high terrace. Industrious examination of the hearths brought to light fragments of bone and chert but no recognizable artifacts. I was, however, able to photograph a large

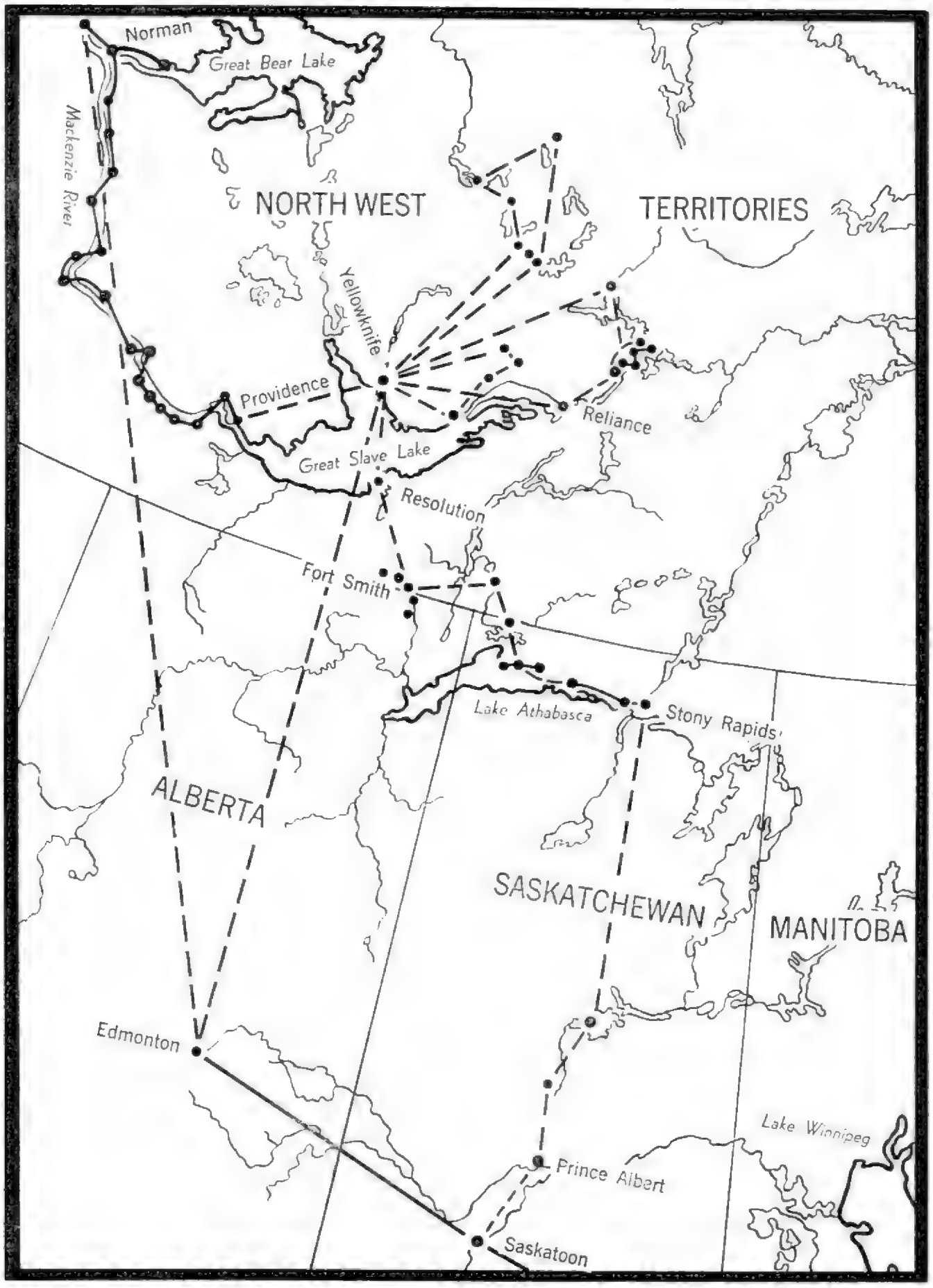
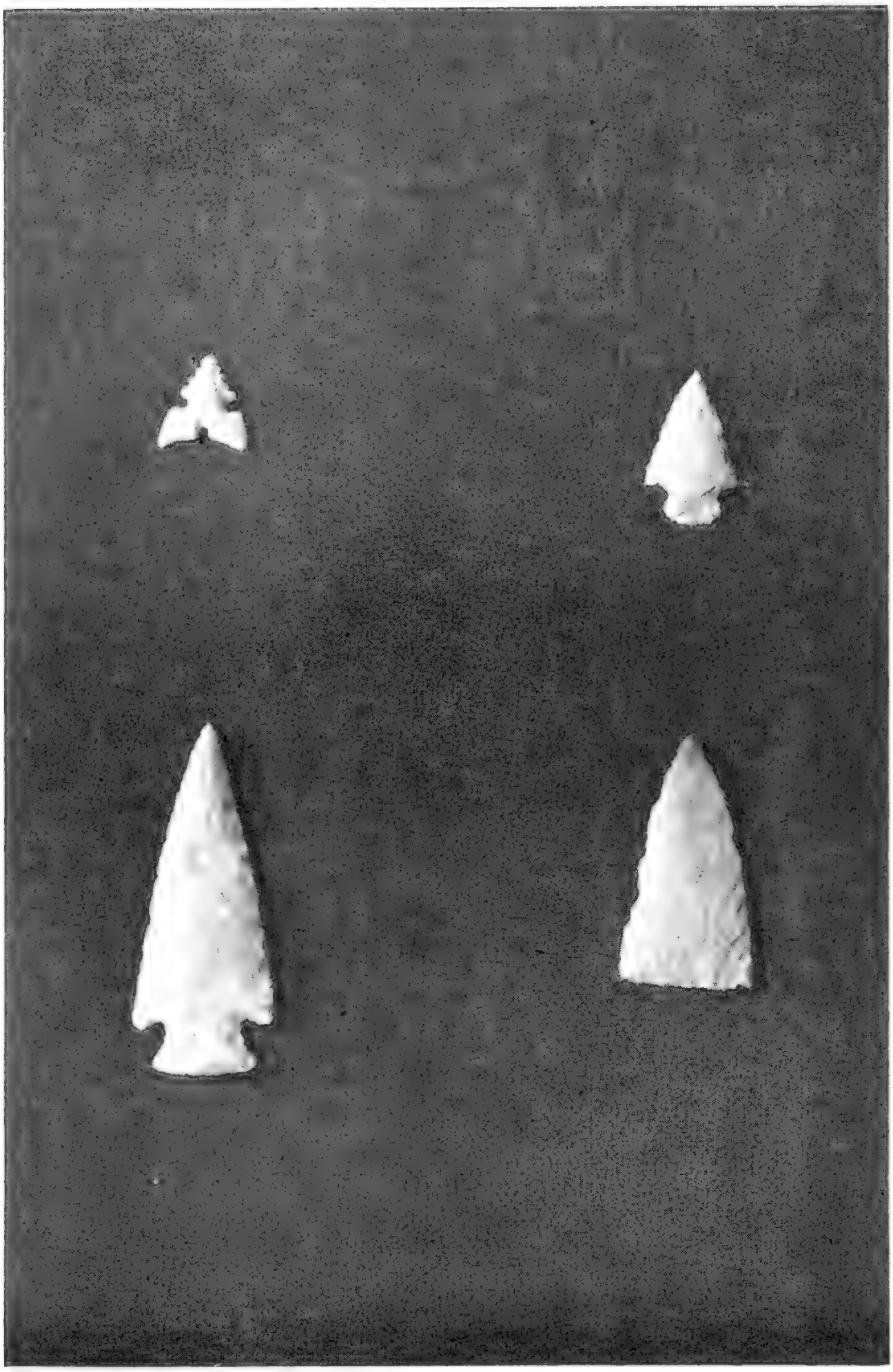


Figure 1. Route of the archæological survey of the Northwest Territories



Artifacts of the Whitefish Lake complex from Whitefish Lake Site, No. 10, N.W.T., natural size

ovoid chert knife that had been given to Dr. Truesdale. From the standpoint of stratigraphy and the possibility of finding a cultural sequence covering a considerable length of time, it is strongly recommended that this site be excavated.

Site 6. Downstream, 15 miles from Fort Simpson on the left bank of Mackenzie River, at R. Saburea's cabin, a hearth is exposed at a depth of 3 feet by excavation for a set of steps down to the river. Cultural materials were absent, and the site is very small.

Site 7. At the entrance of Trail Creek into Mackenzie River, there are cabins on the southeast bank. In looking over the gardens of the village, a hearth was observed $1\frac{1}{2}$ feet down in the wall of a storage cist. It was reported that a stemmed projectile point was found during the excavation of this cist. We found a scraper. Further survey is recommended.

Site 8. At the village on the northeast bank at the entrance of Willow Lake River into the Mackenzie, artifacts were found. The part of the projectile point and the scraper came from the garden of the easternmost house in the village, and on the bank just south of it were observed areas of burned clay and charcoal. Further investigation seems necessary.

Site 9. At the mouth of Ochre River on the north bank, flint chips were found.

Site 10. Four small delicately-made projectile points (See Plate II) were given to K. S. Christie by Mr. A. Brown of Yellowknife. These points were found on a low beach or recent beach of the esker at the northeast end of Whitefish Lake southwest of Fort Reliance. Further investigation of this site seems warranted.

Site 11. This site is on the esker at the northwest end of Artillery Lake. To be more explicit, at the north end of the lake west of the entrance of the Lockhart River is a large bay. Emptying into this bay from the west, parallel to the E-W esker is a small stream, and entering the bay from the north is a stream that bisects the esker. West of this second small stream, directly in line with the island and the point in the bay and just slightly west of the lake north of the esker is a saddle in the esker. In this saddle, marked by a cairn of rock, is an archæological site. Sam Otto and I picked up six flint chips, part of a projectile point, the base of a large blade, a flake side scraper, and two small plano-convex end scrapers. This is mainly a blow-out, and no occupational strata were found.

Site 12. To the north, just off the same bay, is site 12. It is located on a lower beach on the east bank of a small stream from the north that enters the larger stream entering the west end of the bay. It is on the south side of the esker. Three flint chips, three bases of ovoid blades, three parts of projectile points, two pear-shaped plano-convex snub-nosed scrapers, one small plano-convex scraper, one large irregular triangular point, one large flake scraper, one thin prismatic flake knife, part of one short semi-lozenge point, and part of two narrow corner-notched points occurred. Excavation might be worth while.

Site 13. Site 13 is west across the small north-south stream from Site 12 on the same terrace. Two flint chips, two bases of ovoid blades, and one small plano-convex scraper were picked up.

Site 14. Site 14 is about 200 yards west of Site 13, on a high beach east of an old out-camp of Matt. Murphy. Six parts of blades, three bases of ovoid blades, two flake side scrapers, three small plano-convex scrapers, one part of a projectile point, one corner-notched point, one large chopper, two large plano-convex end scrapers, bases of three long narrow lanceolate points with narrow slightly bifurcated bases and diagonal transverse flaking were collected by Sam Otto and MacNeish.

Site 15. Just west of the cabin on the same terrace or on top of the esker were quartzite chips, part of a big blade, a small plano-convex scraper, and four very large side scrapers or choppers.

Site 16. On a lower beach above a small lake on the north side of the esker and east of the small stream entering the centre of the north shore of the bay in the northeast corner of Artillery Lake, Sam Otto gathered two bases of ovoid blades, three flake side scrapers, one part of a large triangular point, and chips.

Site 17. Site 17 is located on a low beach on the south side of the esker directly south of Site 16. Parts of two ovoid blades and a pear-shaped plano-convex end scraper were found by MacNeish.

Site 18. Site 18 is on the same esker as the previous sites but farther east, on the first large sandy recurrence of the esker east of the rocky prominence directly east of Sites 16 and 17. Only part of a knife, a small plano-convex scraper, and a side-notched point were found. It is on the blown-out surface of a low beach.

Site 19. Site 19 is on a low beach along the edge of the bay about 200 yards east of a stream bisecting the northern shore of the bay. A side-notched point, small plano-convex scraper, and a flaker side scraper were picked up.

Site 20. Site 20 is located on top of the west end of the esker cut by Lockhart River between Ptarmigan Lake and Artillery Lake. A flint core, a large quartzite side scraper or chopper, and flint chips were found.

Site 21. This site is on the lower beach north of the esker mentioned above. Parts of two blades, two basal parts of ovoid blades, three small plano-convex scrapers, four parts of projectile points, one pear-shaped plano-convex end scraper, two large flake scrapers, and one side-notched point were found.

Site 22. This site is situated south of the esker mentioned in the description of Site 20. The site is on a long tongue, actually a lower beach extending south from the esker and about 400 yards east of Lockhart River. Small areas of fire-cracked stone, burned clay areas, and flint chips littered the area. The site was quite rich; part of one blade, seven ovoid blades, two flake side scrapers, two small plano-convex end scrapers, three pear-shaped end scrapers, parts of five points, four large flake side scrapers, one prismatic flake knife, four semi-lozenge points, one narrow corner-notched point, two side-notched points, the end of a round-based point, two large narrow crudely chipped daggers or blades, and one chopper were found. This site appears worth digging.

Site 23. Site 23 is also south of the esker and about a quarter mile east from Site 22 on the opposite side of a low swampy area. It is also on a

low beach. Sam Otto gathered part of an ovoid blade, a flake side scraper, part of a projectile point, a pear-shaped plano-convex scraper, semi-lozenge point, one narrow corner-notched point, two side-notched points, one chopper, parts of two round-based points, and some flint chips.

Site 24. This site is just above the second rapids on Lockhart River between Artillery and Ptarmigan Lakes on a high beach north of the portage. Flint chips and one crude ovoid blade were found.

Site 25. Site 25 is located west of Ptarmigan Lake on the shore of the largest lake just west of Ptarmigan Lake and about 100 yards south of a small stream connecting the two lakes. The site is situated on a low beach on the south side of a series of sand dunes or remnants of an esker. One flake scraper, one small humpbacked scraper, and one narrow side-notched projectile point were gathered.

Site 26. This site is located on a high beach at the west end of the large esker emptying into the northeast end of Ptarmigan Lake. Parts of two ovoid knives, two large end scrapers, a flake side scraper, and a round-based quartzite projectile point were picked up.

Site 27. This site is at Caribou Narrows between Clinton Golden and Ptarmigan Lakes on the north section of the point on the east side, on one of the lower beaches. Artifacts found include part of one round-based blade, three small plano-convex scrapers, two end scrapers, and one corner-notched point reworked into an end scraper.

Site 28. Site 28 is on a beach directly above Site 27. Five flake scrapers, one small plano-convex scraper, and one round-based projectile point occurred on it. From the standpoint of sequence of culture associated with beaches of different levels, this site might be worth testing.

Site 29. Site 29 is on the east side of the Cariboo Narrows on a low beach. Two flake scrapers, a round-based point, and a pear-shaped plano-convex scraper were found.

Site 30. Site 30 is on the high beach above the stone cairn at Tyrrell Point and just west of the marker. Numerous flint chips, a contracting stemmed point, and part of a large blade were collected.

Site 31. Site 31 is in the first bay north of Tyrrell Point on the present sandy beach. One small serrated edged blade that may have been part of a corner-notched point was found.

Site 32. A small side-notched point was found in the garden at the terrace at the Hydro plant just north of Yellowknife.

Site 33. A long narrow triangular point with a concave base, and a basal flute were found by Bill Morris in the excavation into the terrace for a sidewalk at the same spot. Cleaning of a soil profile might uncover a buried (and early) cultural strata.

Site 34. Site 34 is located on the south shore on the small sand ridge at the second rapids on the Coppermine River down from Lake de Gras. This is a low beach or remnant of the alluvial fan of an esker. Flint chips, three end scrapers, a small contracting stemmed point, part of two large ovoid blades, one flake side scraper, three parts of projectile points, one pear-shaped plano-convex scraper, one semi-lozenge point, and parts of three round-based points were gathered by our party.

Site 35. This site is at Taltheilei Narrows in the east arm of the Great Slave Lake, on the eighth beach east of the stream bisecting the beaches just inland from a small bay east of Taltheilei Narrows. Gettys Webster and I dug out five large ovoid knives, parts of two crude plano-convex end scrapers, one chipped semi-lunar knife, and a large straight, straight-stemmed point (the stem being only one-quarter inch narrower than the $1\frac{1}{4}$-inch body) that had the end reworked into a drill. The chipping on this point is oblique and often extends more than half-way across the body of the point. The edges of the stem appear to have been ground. All these points are made of shale. A flat pebble that had notches ground on one side and the edges smoothed (a net sinker?) was also found. Since these artifacts are *in* (not *on top* of) the sands of a very ancient beach, the site should be further tested.

Site 36. This site is on the east side of Hill Island Lake. It is near the south end of the lake not far north of the island in the lake at the end of an esker in front of the remnant of an old mining camp. Mush Sharron, Harry Woods, and I found part of a blade scraper, a small plano-convex end scraper, and two large ovoid knives. The site is on a low beach.

Site 37. This site is on the east side of the portage between Beaverlodge Lake and Lake Athabasca. The site is on a high beach and between the two north-south portage roads. Activities on the road and road-building have disturbed the site considerably. Nine parts of ovoid blades, one large crude triangular reject or unfinished point, one chopper, three large side scrapers, one large round plano-convex end scraper, and two ovoid points with narrow indented bases were collected.

Site 38. Material collected by Father Perrin at Fond du Lac consisted of two large ovoid blades and two long narrow points with one side near the base notched or removed (reminiscent of a Sandia point).

Site 39. This site is on the north bank of the river at the second rapid up from the end of Lake Athabasca at Stoney Rapids. Donnie Tilden found a side-notched projectile point at the site, and I found some flint chips.

Site 40. This site is on the point on the east side of Black Lake opposite where Fond du Lac River empties into Black Lake. Unfortunately, I was at the site a short time only and found just flint chips and a flake scraper.

ANALYSIS

The specimens found in the survey are not numerous, nor do many of the sites have large artifact assemblages. Also, the specimens found, with the exception of some from site 35, were surface collections. In spite of these limiting factors it was felt that analysis of them might reveal some significant archæological data.

The first step in the analysis of the specimens from the sites was the establishment of a series of arbitrary classes of artifacts from all these sites. This gave the complete range of the kinds of artifacts found in the survey. Then a correlation of the artifact assemblages and the sites was undertaken. Specifically, the surface of a table was marked off into a grid (so as to form a graph). The ordinates of this grid or graph were the

TABLE I

Correlation of Sites, Beaches, and Artifacts

Geological Stage	Sites on high beaches east of ice sheet in stage 3 at edge of barrens		Sites on high beaches in barrens			Sites on intermediate beaches in the barrens					Sites on modern beaches		
Site number	2	35	37[a]	30	14	21	23	22	12	34	1	32	10
Artifacts—													
Small side-notched and basal-notched points with serrations													1[c]
Small corner-notched points with serrated edge											1[q]	1[q]	2[c]
Small triangular points													1[c]
Small contacting stemmed points										1[q]	1[q]		
Prismatic flake knives							1[q]	4[q]	1[q]	1[q]			
Pear-shaped snub-nosed scrapers						1[q]	1[q]	3[q]	2[q]	1[q]			
Semi-lozenge points							1[q]	4[q]	1[q]	1[q]			
Round based points						2[q]	2[c]	2[c]	1[c]	3[q]			
Long narrow blades								2[c]					
Small irregular plano-convex scraper					3[c]	3[q]		3[q]	1	3[q]			
Side-notched point						2[q]	2[q]	2					
Corner-notched point					1[c]		1[q]	1[q]	2[q]				
Large ovoid blades			9[q]	1[c]	3[c]	2[q]	1[q]	7[q]	3[q]	2			
Large flake scrapers			3[q]		2[c]	2[q]	1[q]	2[q]	1				
Choppers			1[q]		1[q]		1[q]	1[q]					
Lanceolate blade with indented or ground narrow base			2[q]	1[q]	3[q]								
Large plano-convex scraper		1[s]	1[q]		1[q]								
Large crude ovoid points		5[s]											
Semi-lunar chipped blade		1[s]											
Large incipient stemmed point	1[s]	1[s]											
Netsinker(?)		1											

KEY: [c]—chert; [q]—quartzite; [s]—shale; [a]—not in barrens on 800-foot beach of Lake Athabasca.

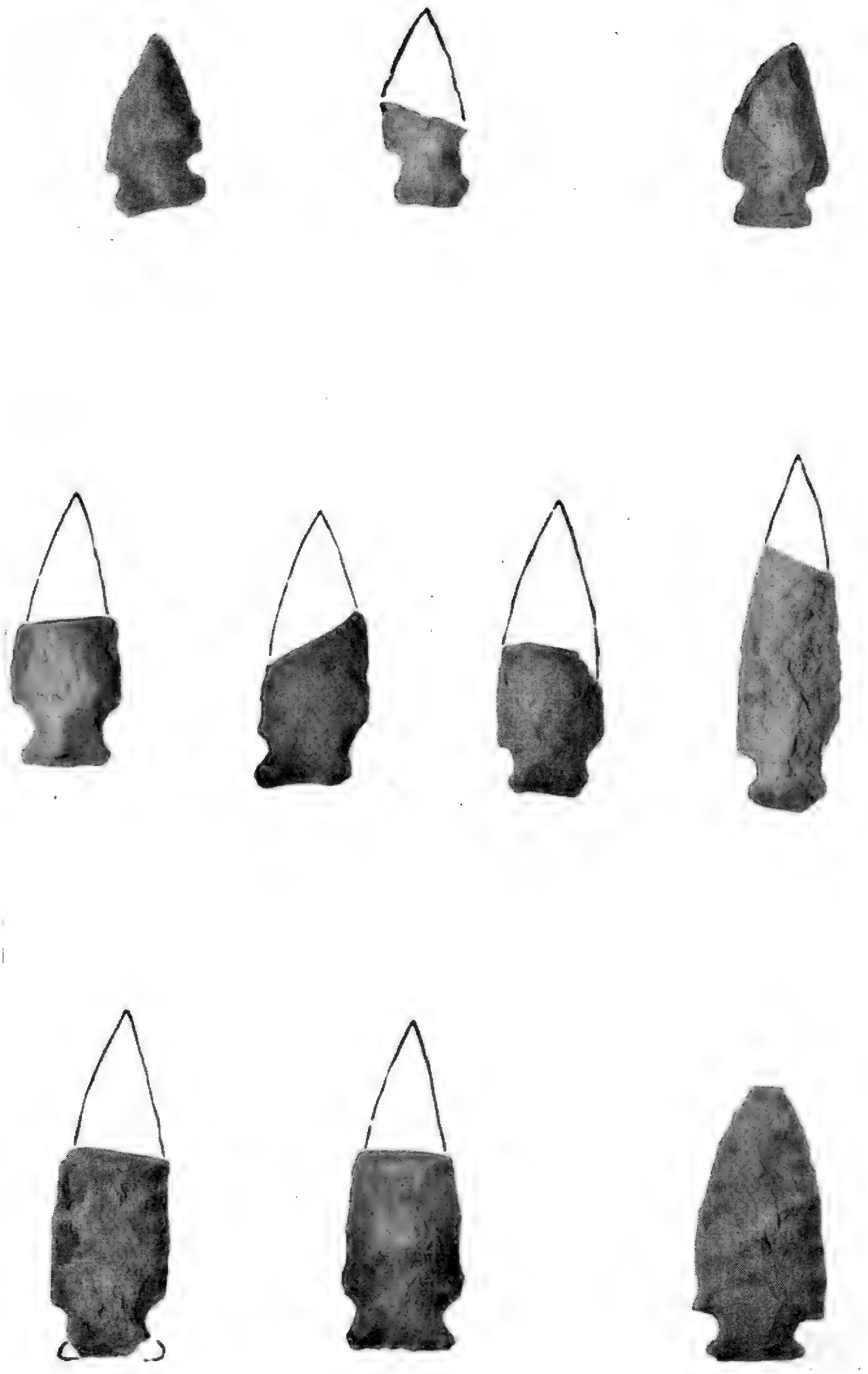
classes of artifacts, and the abscissæ represented the sites; the squares of the grid or the tabular values of this graph were the actual artifacts of the various classes found at their respective sites. Two facts now become apparent: that there were at least four recurring artifact assemblages, which I shall call complexes, and that only thirteen sites had sufficient materials to be classified into these four complexes. Next, a correlation was attempted between the artifact complexes and the geological phenomena. By geological phenomena I mean either the beaches of various heights in the barren lands or the beaches of the post glacial (Athabasca–Great Slave) lakes established by A. E. Cameron[1] and Raup.[2] Table I is a correlation of the geological features with the artifact classes at the thirteen sites.

Sites 1, 32, and 10 composed the poorly defined but distinctive Whitefish Lake complex. All the points are extremely small and delicately chipped. Distinctives of the complex are the small, triangular, corner-notched points and the small, side-notched—basal-notched serrated-edged point (See Plate II, Nos. 1 to 4). The small contracting stemmed point may also belong to this complex. The points are made from either quartz or chert. The presence of these points on modern beaches and the fact that they are similar to points that, everywhere in eastern North America, appear with sites in the last stage of prehistory or early historic stage would seem to indicate that the Whitefish Lake complex is the most recent of our four complexes. Just what this means in terms of years is difficult to say; roughly, the Whitefish Lake complexes were in existence somewhere between 1000 and 1830 A.D. More exact dating must await further work.

Sites 21, 23, 22, 12, and 34 have a large number of classes of artifacts in common and seem to represent a definite complex, which I have called the Lockhart complex. Distinctive of this complex are the semi-lozenge points, the pear-shaped snub-nosed scrapers, round-based points, small plano-convex scrapers, side-notched and corner-notched points (See Plates III, IV, V, and VI). There also appear with this complex, prismatic flake knives, long narrow blades, large ovoid blades, large flake scrapers, and a chopper (See Plate VI). Artifacts are usually made from quartzite. Generally speaking, these sites appear on the middle beaches in the barren lands and not on the modern or high beaches. In terms of chronology, their absence on modern beaches would seem to indicate that this culture precedes the Whitefish Lake complex. Moreover, the presence of artifacts of this complex at Site 12 on a beach directly below the material of the Artillery Lake Complex at Site 14, which is on a high beach, may indicate that the complex follows the Artillery Lake complex. The seriation of artifacts in Table I tends to confirm such a sequence, but further, more definite evidence is still needed. One thing is certain: this complex, from its presence in the barren lands east of Great Slave Lake must have been after the Ice Sheet left the area, estimated by Raup as being from 4,000 to 7,000 years ago. My personal estimate of this culture would be that it existed from 1,000 to 4,000 years ago. Comparatively speaking,

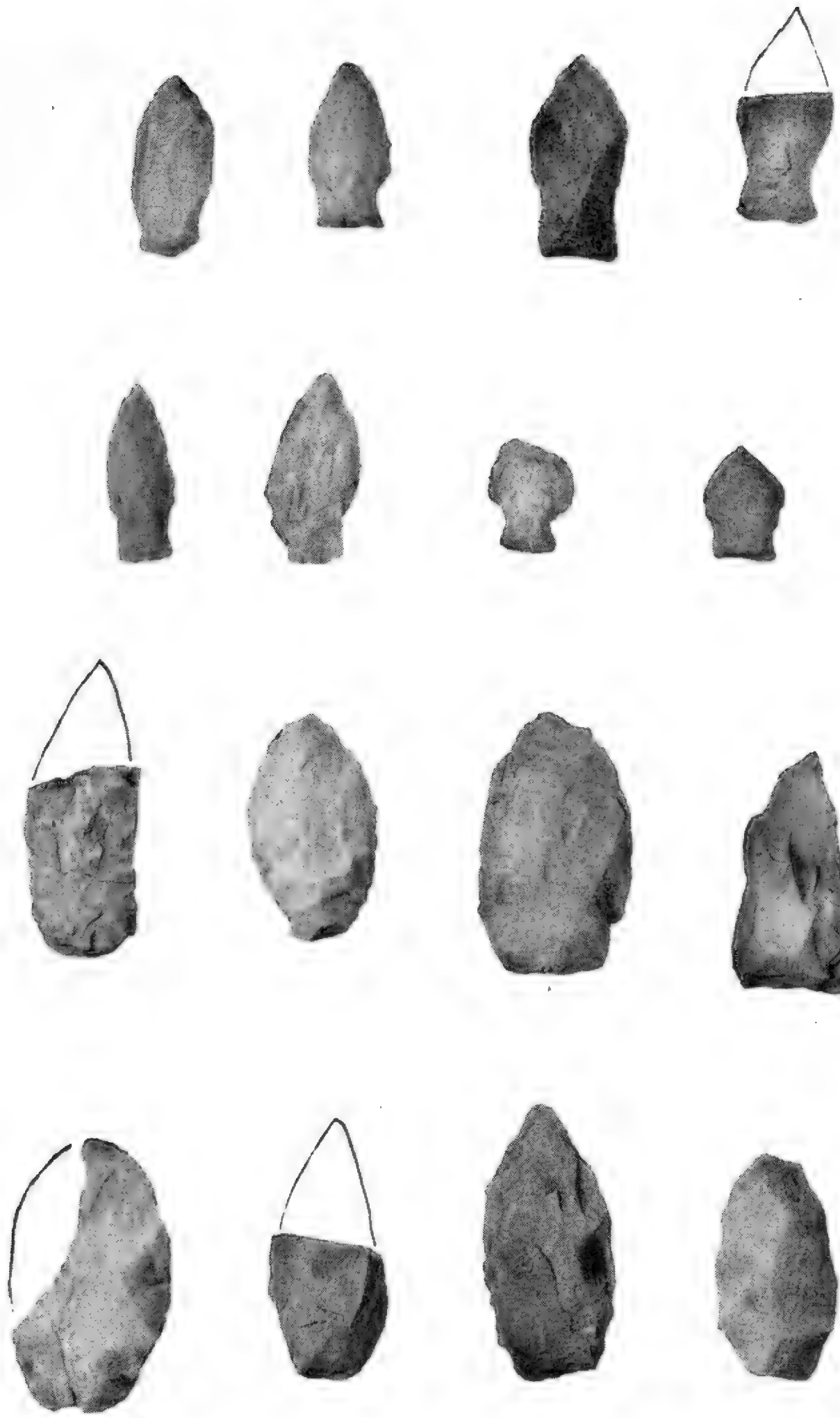
[1] A. E. Cameron: "Post-Glacial Lakes in the Mackenzie River Basin, Northwest Territories, Canada," Journal of Geology, vol. XXX, University of Chicago Press, Chicago, Illinois, 1922, pp. 337-353.

[2] Hugh M. Raup: "Phylogeographic Studies in the Athabaska-Great Slave Lake Region II," Journal of the Arnold Arboretum, vol. XXVII, No. 2, p. 71, Jamaica Plain, Massachusetts, 1946.



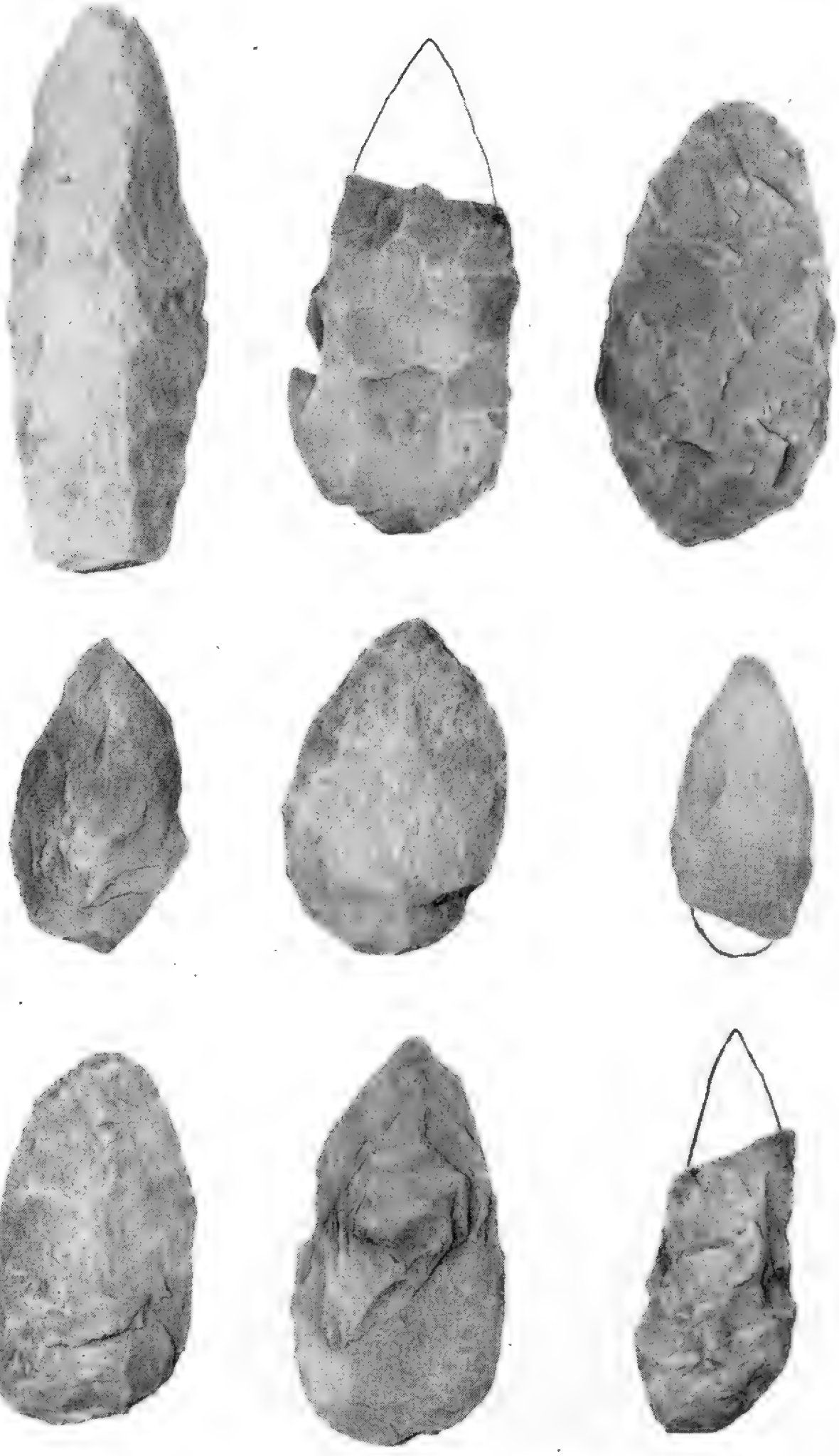
Corner-notched and side-notched points of the Lockhart River complex, ½ natural size
(Neg. No. 103561)

PLATE IV

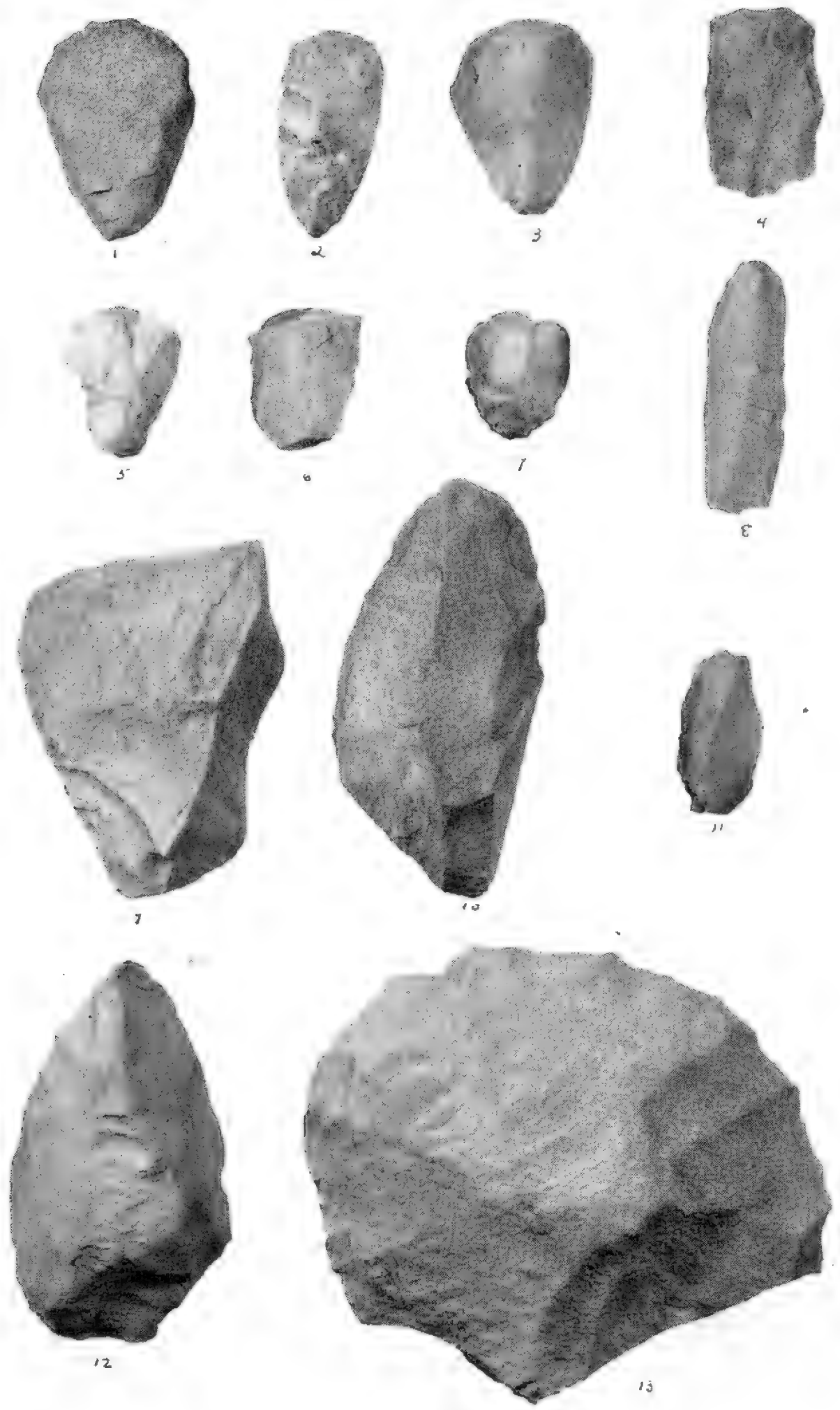


Semi-lozenge and round-based projectile points of the Lockhart River complex, $\frac{1}{2}$ natural size (Neg. No. 103560)

74811—4½



Large blades of the Lockhart River complex, $\frac{1}{2}$ natural size
(Neg. No. 103555)



Lockhart River complex: 1 to 7—pear-shaped end scrapers; 8,11—flake scrapers or knives; 9,10—large plano-convex scrapers; 12,13—choppers. $\frac{1}{2}$ natural size (Neg. No. 103563)

the artifact assemblage of the Lockhart complex resembles rather vaguely that from the Larter site near Winnipeg[1] and the Laurentian materials in northeastern North America.[2]

However, the gaps in our knowledge of areas in between, of the time period, and of the total trait complex must be filled before any relationships may be deduced.

The Artillery Lake complex is represented by only a few sites, those not having large numbers of artifacts on their surfaces. Artifacts are always made of quartzite. The most distinctive artifacts of this complex are the long, narrow lanceolate points with narrow, straight, or convex bases. The flaking on their blades is well done, and parallel (sometimes oblique) flakes extend half-way across the blades. (See Plate VII, Nos. 7, 8, 9). Usually associated with those points are large and small plano-convex scrapers, large flake scrapers, choppers, and large ovoid blades. In terms of chronology, these sites may precede those of the Lockhart complex for the reason previously mentioned. The sites cannot be older than 4,000 to 7,000 years, as they are in the area previously covered by the ice sheet at the end of Great Slave Lake.[3] In terms of relationships with other cultures we are again hampered by lack of data and great distances. The "Long point" of the Hot Spring focus of South Dakota[4] and some of the points from the pre-pottery levels at Starved Rock, Illinois[5], certainly resemble the lanceolate, narrow, indented-based points diagnostic of the Artillery Lake.

The final complex is the Taltheilei complex. Only two sites, Nos. 2 and 35, are of this complex, and only Site 35 had many artifacts. The long incipient-stemmed narrow points occurred at both sites. The edges of the stems on both points have been ground, but the surface of the blade bears long, narrow parallel flakes, and the edges have fine retouching. At Site 35, crude ovoid knives, a large plano-convex end scraper, a semi-lunar chipped blade, and a notched and ground flat pebble were found. All artifacts (except the last) are chipped from shale commonly found in beds at the east end of Great Slave Lake. Perhaps as important as the artifacts themselves was the fact that Site 35 was in part covered by humus and sands on a beach about 700 feet above sea-level and 100 feet above the present level of Great Slave Lake. In terms of Cameron's study of the northern lake, this site would have been on a beach during the third stage when the ice sheet was at the end of the east arm of Great Slave Lake. Site 2 also may have been west of this same glacial front. If it is true that Site 35 is contemporaneous with the building-up of the beach it is on and that Site 2 is contemporaneous with its associated beach, then this complex is older than 4,000 to 7,000 years and younger than 10,000 to 12,000 years.[3] This, of course, would be the earliest complex in the area, if this is true. Only excavation of Site 35 can confirm such a dating, and it is hoped this can be done soon. Cultural relationships to the Taltheilei complex are at best very general. The similarity of the Taltheilei projectile points to Yuma points has been remarked on, but any relationship is of a most tenuous nature at our present state of knowledge.

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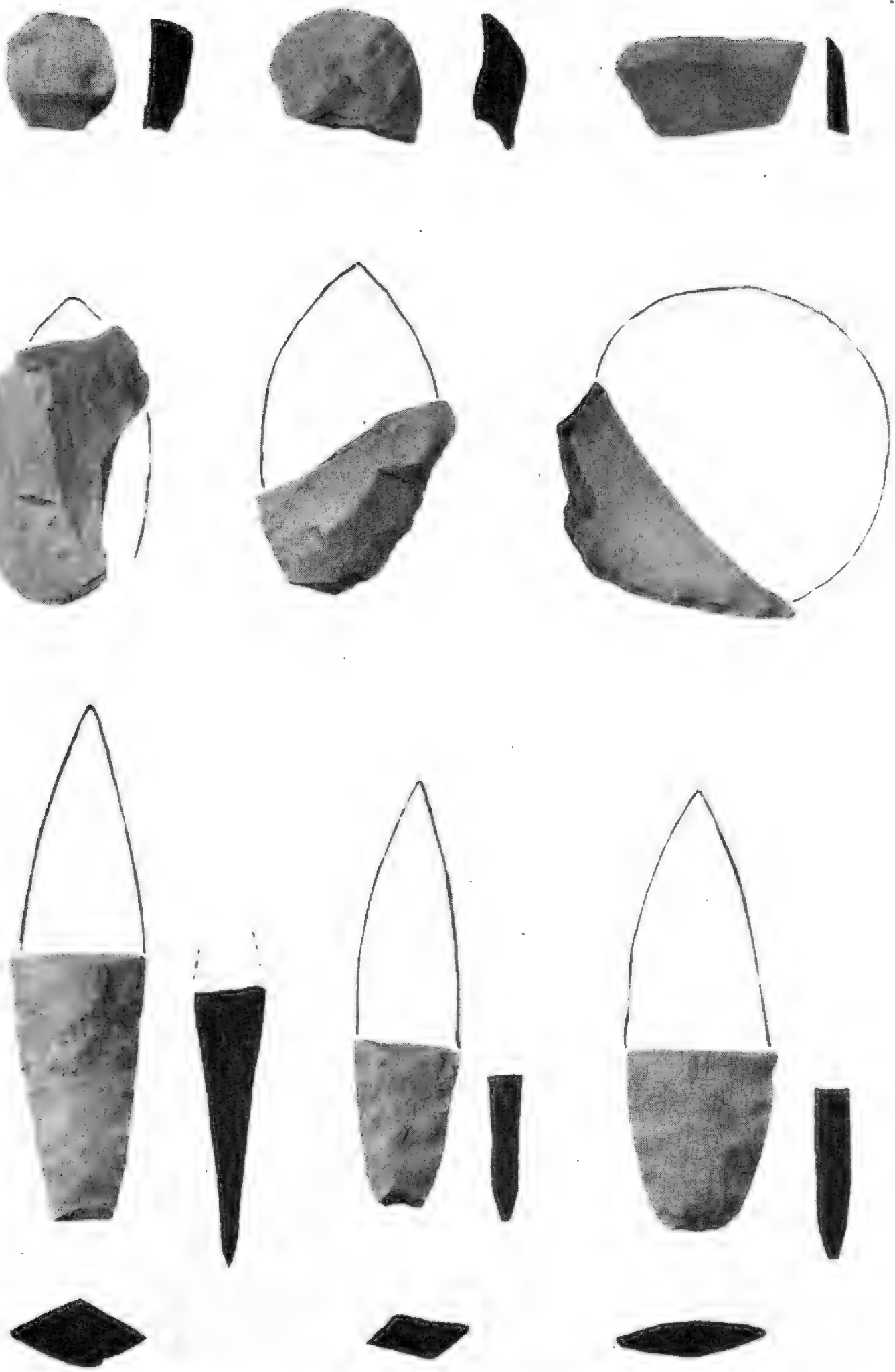
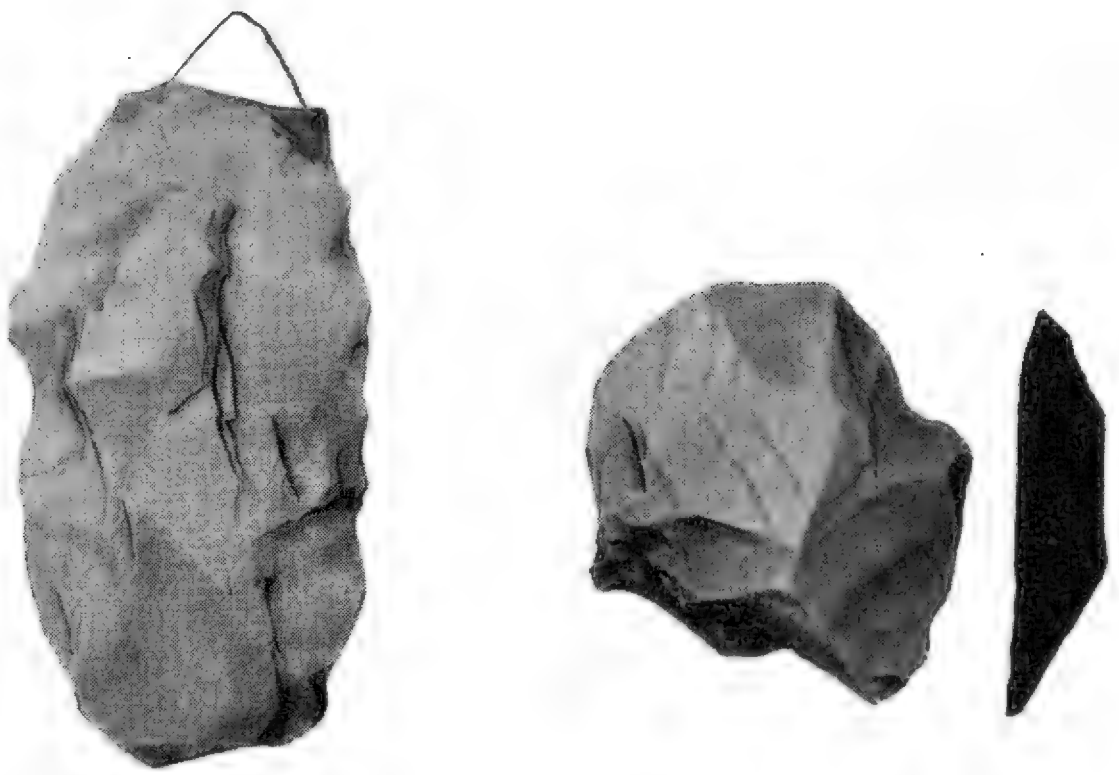
[1] Douglas Leechman has made collections from this site.
[2] William A. Ritchie: "The Pre-Iroquoian Occupation of New York State," Rochester Museum, Rochester, New York, 1940.
[3] Raup, 1946, p. 71.
[4] Jack T. Hughes: "Investigations in Western South Dakota and Northeastern Wyoming," American Antiquity, vol. XIV, No. 4. Menasha, Wisconsin, 1949.
[5] Personal communication with Mayer Oakes of the Carnegie Museum at Pittsburg, Pennsylvania.



Artifacts of the Artillery Lake complex, ½ natural size
(Neg. No. 103568)



Artifacts of the Taltheilei complex, ½ natural size
(Neg. No. 103554.)

In summary, our survey indicated the existence of four cultural complexes in the general area north and east of Great Slave Lake and Lake Athabasca. Tentatively, these complexes may be placed in chronological order with the earliest being the Taltheilei complex (perhaps more than 7,000 years old), followed by the Artillery Lake complex, and then the Lockhart complex which ends with the Whitefish Lake complex that may extend almost up to historic times. This chronology is still too tenuous and knowledge of the area too poor to have it applied at present to the basic problem of the migration of man and diffusion of culture from Asia into America. Perhaps the most definite result of the survey is the discovery that intensive reconnaissance and excavation are necessary in the Mackenzie River drainage and that further surveys, supplemented by digging, are necessary for the region to the east.

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A PRELIMINARY REPORT ON AN ARCHÆOLOGICAL SURVEY OF SOUTHWESTERN ONTARIO IN 1949

By Thomas E. Lee

INTRODUCTION

The investigations described in the present report were carried out in southwestern Ontario during the period of June 15 to August 30, 1949. The prime objectives were the determination of the distribution of Neutral and other cultures, stratigraphic information or sequences of cultures for pottery-making Indians, and the establishment of the presence of preceramic or non-ceramic cultures. The degree of success achieved is due in large part to the splendid co-operation of farmers who permitted examination of their lands, to collectors who displayed their materials or guided us to sites discovered by them, and to others who contributed services. Skeletal material and five hundred artifacts were presented to the National Museum.[1] Assistance in the field was rendered by Walter M. Hlady. The loan of an automobile by the Museum of Anthropology, University of Michigan, is gratefully acknowledged.

The area under consideration is that lying between Niagara River on the east and Detroit River on the west, northwards from Lake Erie to a maximum distance of 40 miles. For convenience, headquarters were established at a midpoint, Aylmer, where equipment was received and artifacts were stored. Previous experience in the Aylmer area led to an examination, first, of sites within a radius of 10 miles. A check was then made eastward to Hamilton and Welland. On the basis of new information the Aylmer area was re-examined, following which the country was checked westward to Windsor. Correlations of soils with types and frequencies of sites were observed, in addition to topographic conditions and vegetation. Some areas were marked for concentrated study; noteworthy among these were Point Pelee, Caradoc Township, the Ingersoll area, the Port Rowan area, Long Point, and the Aylmer district. In the case of Point Pelee it became apparent that a thorough and extensive examination would be required in another season, taking in Pelee Island and possibly some of the Ohio-owned islands. Subsequent studies show that the Sarnia area should be included.

Methods employed were the usual survey procedures: choosing important areas on the basis of studies of topographic maps with respect to lakes, rivers, streams, and elevations; getting in touch with collectors and farmers; photographing collections when these were documented or from a single site or small area; examination of sources of materials found in collections; location of sites by personal observation of topographic and soil conditions in selected areas; and test-trenching when justified. A few sites were surveyed by Brunton compass; sketch maps were made of others.

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[1] Following is a list of those individuals whose donations to the National Museum were submitted through the 1949 survey: Charles Whitcroft, 3 (artifacts); Marcel Gervais, 2; Alex. Franklin, 14, 1 sherd; C. Meuse, 4; Gerald VanPatter, 3; R. Williams, 1; Gordon White, 1; W. Burdick, 2; J. Sofalvi, 6; Mr. MacDonald, 1; J. Hewitt, 12 sherds; Walter Rodgers, 36; Hugh Jones, 105, 2 sherds; M. York, 32; Dr. W. V. V. Pardy, 2 sherds; Mance Fisher, 4 sherds; Mr. Lukes, 1; Donald Tilden, 1, 9 sherds; Margaret Currie, 255, 3 sherds.

Eighty-eight sites were located; approximately 6,500 artifacts and sherds were acquired. In addition, considerable skeletal material, charcoal specimens, and refuse remains were preserved for study. Two hundred and forty photographs were taken of sites, test trenches, and specimens in collections. One hundred and two collections were located, of which forty were photographed; twenty others were examined and sketched. Four collections were donated in their entirety.

Sites located vary in size from small or limited occupations represented by only a few sherds, flint spalls, and stone artifacts, to village sites of about eight acres in extent. Most of them reveal uniform cultural remains, but several indicate repeated occupation. Crop conditions at the time prevented trenching of the latter, but farmers expressed willingness to have sites tested when crops would not be damaged. Nearly all of the large sites are under cultivation.

Exact location of all sites has been recorded for the files of the National Museum.

Cultural development in New York has been worked out from earliest to historic times in the following sequence: Archaic (pre-ceramic), Early Woodland, Middle Woodland, Late Woodland, and Final Woodland. This classification scheme is suitable for Ontario and is employed in this paper, although the term pre-ceramic is preferred to Archaic.

PRE-CERAMIC PERIOD

Some consideration was given to the possible existence of pre-ceramic sites in this section of Ontario, in view of the finds near Killarney and in New York State. Nothing comparable in age to Killarney was found, but points resembling Plainview and Eden types were observed in collections.

Twenty sites are believed to be non-ceramic, on the basis of surface collections. All but two rather doubtful examples and one representing the closing phases of pre-ceramic development occur at elevations of 775 feet or higher.[1] The general level of surrounding land is from 25 to 160 feet lower. Locations are on the shores of former glacial lakes, along old stream-beds, or upon high blue clay knolls and ridges. Several of the sites are unsuited to primitive agricultural methods. At some, water is now obtainable only at the bases of hills, and it seems unlikely that springs were ever present in these particular formations. Excavation is required to establish firmly that the sites were in fact habitation areas rather than workshops, but the probability is that they were occupied at a time when the lower land areas were either under water or in a marshy condition. Certainly elevations are such as to allow for the exposure of considerable land masses with the lowering of glacial lake levels. It is possible that small hunting bands entered this area from the Killarney region as suitable conditions developed.

Sites are distributed well back from Lake Erie, principally in the Sparta district and along the Thames River. Two sites occur on the shores of Whittaker Lake; test trenches here revealed flakes of flint and small fragments of charcoal scattered to a depth of 16 inches through glacial till showing no other evidence of disturbance.

[1] Present level of Lake Erie: 572 feet.

Cultural manifestations at all of the sites include numerous coarse flint cores, crude blades, and a high percentage of flake, end, and side scrapers. Many flakes were used without retouch. Some cores appear to have been shaped or used for scraping. A few sites produced from one to four broad-bladed notched projectile points. A crude chipped and partially smoothed slate celt and a fragment of shale engraved with a pattern of criss-crossed groups of parallel lines were found on neighbouring sites at Sparta.

The type of flint is usually a distinctive mottled grey and brown, markedly different from most of the material found on ceramic sites. Probably it was obtained from river gravels.

One late pre-ceramic site is tentatively assigned to the Brewerton Focus of New York. It has produced chipped slate blades, polished slate artifacts, and evidence of extensive use of slate, shale, and micaceous schist. At one end of the site a single body sherd was found—probably evidence of much later occupation by Neutral peoples.

Pre-ceramic materials were observed in collections, principally in the central and western part of the area surveyed.

EARLY AND MIDDLE WOODLAND

At Thamesville the remaining low stub of a former "conical" mound was examined in connection with early reports of red ochre burials, "clay bowls," and abundant copper artifacts. Nothing was found other than bits of shell and bone in dark earth, although five copper beads from the mound were examined in collections. Red ochre burials are reported in the vicinity. The owner of the mound is contemplating levelling it by bulldozer to facilitate cultivation and cropping of the field.

The earliest ceramic sites found appear to equate in culture with Point Peninsula II and III of New York State. Possibly two or three sites belong to the Early Woodland Period; pending excavation they are placed in Middle Woodland. None of the ten sites located was tested; identification is based upon surface finds of potsherds. All occur on sandy soil along Lake Erie or within a few miles of it, between Port Bruce and Long Point. One in Norfolk County yielded Vinette Dentate, Point Peninsula Rocker Stamp, and St. Lawrence Pseudo-scallop Shell types of sherds. Coil marks are prominent in the sherds from several sites.

Many of the collections examined between Aylmer and Windsor contain Point Peninsula artifacts. In all likelihood, sites occur in that area—especially around Chatham and Point Pelee. Two sites—one at Thamesville, one at Kingsville—may be assigned to Point Peninsula when better samples of material are available. Very few collectors were contacted or reported to us along Lake Erie eastward from Aylmer.

Point Peninsula artifacts and sherds were examined in collections in the Ingersoll-Woodstock area. One sherd bears a complicated stamp pattern; its association with Point Peninsula cannot at present be determined.

A study of pottery in collections from Point Pelee suggests that transitional sites occur here, falling between Point Peninsula and Owasco.

Sites were in fact located in the closing days of the survey, but little surface material was found, and excavation was not attempted. Some Hopewellian elements occur in collections.

LATE WOODLAND

Nine sites are tentatively assigned to Owasco of the Late Woodland Period; of these, two were test-trenched. Distribution of sites is roughly similar to Point Peninsula, and, likewise, locations are on sandy soil—on sand ridges or along river-banks and the shores of Lake Erie. Resemblance to some of the New York Owasco types is very close—especially in the case of Owasco Platted. The latter was obtained from test trenches in a site at Long Point, differing only in having a row of spaced nodes round the outside of the rim.

Several collections between Aylmer and Windsor contain Owasco sherds and artifacts. Noteworthy is the Coppieters collection at Chatham.

A site near Chatham has yielded pottery closely related to that on the Wolf Site in Michigan, which Greenman places in the Whittlesey Focus in Ohio.[1] Possibly related, but certainly earlier, material has been found at Port Bruce.

Ten related sites were found on sandy soil along small streams from Port Rowan on the east to Wheatley on the west, and northward to Mount Brydges. Material from them is typologically later than Owasco and earlier than Uren, though containing elements of both. General resemblances between the sites in ceramics and stone artifacts, together with the fact that they are as a whole distinct from either earlier or later materials, justifies placing them in a separate focus, here designated Glen Meyer. Statistical analysis has demonstrated trends toward Uren, with cord-wrapped paddle edge decoration decreasing while incising increases.

The sites tend to be large, ranging up to 10 acres in size. Excavation will be required to determine whether they were fortified. Several are in good defensible positions on high ground.

Among the earliest sites of the group is the Goessens Site at Glen Meyer. It covers about 7 acres and lies on high sandy soil in the fork of a gully and a ravine. Although stumped 2 years ago, it has not been seriously damaged. Some fifteen features are readily apparent on the surface, as revealed by erratic growths of vegetation and concentrations of ash, sherds, and bones. Test trenches showed undisturbed ash beds within 2 inches of the surface. Fifteen hundred sherds were collected on the surface, together with numerous stone artifacts. Dr. R. S. MacNeish visited the site in October and concurred in the opinion that it ought to be excavated as soon as possible to avoid further damage.

A site in a sand pit along Thames River may belong to early Glen Meyer. Insufficient sherds were found for certain identification. An outstanding feature of the site was scattered human skeletal material of at least three individuals. Excavations revealed that some of the long bones and a scapula had been neatly stacked nearby in a pile resembling a carefully prepared outdoor fire. A thin saucer-like lens of grey ash under the

[1] Greenman, E. F., *The Wolf and Furton Sites, Macomb County, Michigan*. Occasional Contributions from the Museum of Anthropology, University of Michigan, No. 8, 1939, p. 25f.

pile enhanced the resemblance. Evidently this was not a burial. All pottery found lay outside the skeletal area, but may have belonged with two skeletons reported removed earlier by machinery in the pit.

Glen Meyer pottery was observed in only four collections.

A small site near Aylmer was examined, which appears to fall between Glen Meyer and Uren—the earliest of W. J. Wintemberg's Neutral sequence, termed by him proto-Neutral. All material was obtained from test trenches. It may be of considerable significance, if sufficient undisturbed areas can be found. A great deal of digging has apparently taken place there.

FINAL WOODLAND

A number of Neutral sites were discovered, and examinations were made of the Clearville, Southwold, Pound, and Middleport Sites. From Pound and Middleport, surface collections were made. Deviations from material reported by W. J. Wintemberg are only slight, and all sites can be fitted into his sequence. Such stratigraphy as was revealed is in complete agreement with his work. Emphasis was not placed upon investigation of this Final Woodland Period development.

Two Uren-type sites were found—one at Aylmer, one near Strafford-ville. Both are on sandy soil. The former was test-trenched, revealing deposits 2 feet thick, with Uren in the lower levels; on top was later Neutral material insufficient for identification. Several ash beds were visible on the cultivated surface.

Middleport-like material was obtained from a site on sandy soil near Aylmer and from a stratified site near Avon. The latter is on heavy soil and contains several refuse deposits 2 feet thick. Test trenches revealed the presence of Middleport, Pound, and Lawson types of sherds. Subsequently, the more obvious features of this site were seriously damaged by activities of local treasure seekers.

Lawson-type sites were examined but not tested, with the exception of one near Hamilton. A village site near Brownsville has been largely dug over. The site of now obliterated earthworks near Whittaker Lake yielded celts only. It is on high land and on heavy clay loam.

An almost undisturbed earthwork was located near Kingsville. Testing was not permitted, but a photographic record was made. Note-worthy is the presence of a spiral bastion at one point of the otherwise circular embankment.

In the Port Bruce area a remarkable mortar stone was examined. It is a flat-topped block of granite approximately 7 feet in diameter, with a dozen shallow hollows and a centrally located deeper basin—all highly polished. Farmers reported that a number of attempts had been made to break it up with charges of dynamite; in digging down around the big stone, workers had come upon a muller stone, which was obtained by the survey.

Some 400 yards distant and across a small stream is another mortar stone, somewhat smaller and less well polished. A third stone nearby seems to have been slightly used. Almost certainly a village site exists

at no great distance, but all attempts to find it failed. Much of the soil—particularly around the largest stone—is heavy clay. The area should be examined when not in crop or pasture.

SUMMARY AND SPECULATIONS

Within the area examined and especially in the central part where the highest land occurs are several pre-ceramic sites which, on the basis of surface finds, appear to be earlier than Laurentian. Excavations will be necessary to determine their exact character. It is highly probable that similar sites could be found on the high ridges northwards from London. Only one Laurentian site was found, and no connection with the supposedly earlier sites is seen at present.

No Vinette I of Early Woodland was found, but several sites producing the later types of Point Peninsula pottery are located in the eastern part of the area surveyed. Material in collections suggests that sites exist in the western part also.

Collections from Point Pelee contain ceramic material, possibly transitional from Point Peninsula to Owasco, with some Hopewellian influence. Contact with Ohio via Pelee Island and the Ohio islands is worthy of consideration; Hopewell-like material has been reported from Pelee Island.

Material related to New York's Owasco is present over much of the area, as indicated both by survey findings and by private collections. It is here suggested that it represents a development from a complex similar to that observed at Point Pelee, with Hopewellian influence declining while other influences continued to come in from New York and Michigan; further work in the Point Pelee area is much needed.

A sequence of development and change within a group of sites, which I designate as the Glen Meyer Focus, suggests continuity from Owasco to Uren, although further investigation of the earlier part of the sequence is required. There is more than a hint of Hopewellian influence here; it may be considered seriously whether such contact was through the Saginaw Bay region of Michigan, derived from Illinois Hopewell. If such was the case, the Sarnia section of Ontario may be expected to reveal evidence of contact.

Distribution of the Neutral sequence of development worked out by W. J. Wintemberg was not determined, but certain observations were made. Uren material was not found west of St. Thomas, although it does occur at Chatham; it tends to cluster in the central part of the area. Later types were found over a wider area—especially from London to Hamilton. Neutral remains became progressively scarcer westward from St. Thomas, occurring only as scattered chance finds in the extreme western area, with the exception of one large earthwork.

The principal problems raised by the survey are:

(1) Determination of the exact nature of pre-ceramic sites by adequate test-trenching; and obtaining more information on their distribution.

(2) Establishment of the non-ceramic character of the supposed Brewerton site by test-trenching.

(3) (*a*) Full identification of Point Peninsula sites by test-trenching; and searching for possible traces of Early Woodland and Vinette I.

(*b*) Examination of Blandford Township for larger Point Peninsula sites and possible associations of complicated-stamped pottery.

(4) Locating and testing sites in the Point Pelee area in connection with transitional possibilities and Hopewellian influences: this involves examination of Pelee Island.

(5) Examination of the Sarnia area for evidence of Hopewellian contacts.

(6) Location of possible transitional sites of late Owasco or early Glen Meyer.

(7) Further testing of a possibly transitional pre-Uren site at Aylmer.

(8) Stratigraphic information covering the various periods. Several stratified sites have been marked for testing.

In conclusion it is pointed out that certain definite trends in cultural development are indicated by the findings of the survey. Although serious gaps exist, these are believed due to the lack of reported or discovered key sites. From early Glen Meyer on, there seems little cause for doubt that development was consistently in the direction of Uren and thence on to historic Neutral. The implications are that considerable time depth is involved in the development within Ontario of the Iroquoian culture attributed to the Neutral peoples of the area; this is of great significance in considerations concerning the pre-history of the entire northeastern part of the continent.

EXCAVATIONS AT THULE CULTURE SITES NEAR RESOLUTE BAY, CORNWALLIS ISLAND, N.W.T.

(Preliminary Report)

By Henry B. Collins

The recent establishment of weather stations and air transport in the Parry and Sverdrup Islands in the northern part of the Canadian Arctic Archipelago has opened up a vast new field to scientific exploration. Archæologically, this is the last great unexplored area in the American Arctic. There are no longer any Eskimos on these northernmost islands, but in the past they must have lived there in considerable numbers, for the Franklin Search parties in the 1850's reported old house ruins at numerous places along the coasts. In the summer of 1949, at the invitation of the National Museum of Canada, I was able to make the first archæological investigations in this region. The project, like that of the previous summer at Frobisher Bay, was under the joint sponsorship of the National Museum of Canada and the Smithsonian Institution. I was assisted by J. P. Michea of the Museum Staff, who had worked previously among the Caribou and Ungava Peninsula Eskimos.[1]

On May 25, Mr. Michea and I left Goose Bay, Labrador, by plane, stopping for a few hours at Frobisher Bay and at Thule, in northwest Greenland. After dropping mail and supplies by parachute at the weather stations on Ellesmere, Ellef Ringes, and Prince Patrick Islands, the plane landed at Resolute Bay on the south coast of Cornwallis Island, early on the morning of the 27th. The Resolute Bay area was still blanketed in snow, and wintry weather, with high winds and snow, continued for more than two weeks after our arrival. During this period, trips were made by snowmobile to the east and west of Resolute Bay to examine old Eskimo house ruins and tent rings, of which there were considerable numbers, particularly in the vicinity of Cape Martyr, a few miles west of the Bay. We began excavating on June 13, spending the first three days digging the ice from inside and around the houses that had been selected for excavation. The work continued until August 23 when the ground had begun to freeze again.

There are four old Eskimo village sites in the vicinity of the Resolute Bay weather station, in addition to numerous tent rings, stone-floored temporary house sites, stone caches, and fox traps. The nearest site, which we called the Lake site, is about a quarter mile from the station and about half a mile back from the shore. It is situated on low ground between two lakes and a small stream which flowed from the larger lake. The site consists of nine house ruins, appearing as low mounds, with narrow entrance

[1] Grateful acknowledgments are due to Dr. F. J. Alcock, Dr. Diamond Jenness, and Col. Graham Rowley, who first suggested the joint program of archæological work reported here and in the preceding Annual Report; to Mr. Andrew Thompson, Controller, Meteorological Division, Department of Transport, and Mr. C. J. Hubbard, Chief, Arctic Section, U.S. Weather Bureau, who arranged for our transportation and living quarters at the Resolute weather station; to the U.S. Air Force and the Royal Canadian Air Force; to Bill Rae and Stewart W. Dewar, Officers in Charge, and the other men at the station, particularly R.C.M.P. Constable Harry Aime, through whose efforts the archæological sites had been protected; to Wilfred Schofield, Department of Agriculture, Ottawa, for advice and assistance in plant collecting; and to the National Geographic Society and the Arctic Institute of North America for the loan of valuable photographic and other equipment.

passages, stone floors and sleeping platforms, and walls of stone and turf. The form of the roof is conjectural; it was probably supported by whale bones—later removed to build other houses—and covered with turf. Three of the Lake site houses were selected for excavation—House B (Plate IX A, B), which appeared to be the latest of the group, and Houses E (Plate X A, B) and I, which seemed to be the oldest, as they were much more filled in. The main part of House B was oval in shape with an oval room with sleeping platform adjoining it on the left, giving the structure as a whole a bilobed appearance. It was 12 feet long by 16 feet wide and was entered by means of a passage 19 to 36 inches wide and 6 feet long. The structural features of the other two houses were more difficult to determine, as they apparently had been partly dismantled to obtain whale bones and stone slabs for later construction, possibly of House B. House E proved to be a complex structure, almost twice as large as House B. On the floor was found a quantity of blubber-soaked refuse consisting of pieces of seal and polar bear hide, baleen, sinew, feathers, animal bones, and implements. This material was unusually well preserved, because it was covered by pure ice, part of a great mass that extended over the floor and passage areas. This was probably formed from snow which had drifted in after the house had been abandoned. Secondary use of the house was indicated by another stratum of soil and refuse, lying above the ice and below the surface sod. A unique find, from below the sleeping platform at the rear of House E, was a row of feathers set between two narrow 27-inch long strips of baleen (Plate XIII B). Among the material from House I was another object new to Eskimo culture—a composite stone and pottery lamp, the base consisting of a segment-shaped slab of limestone with a side of pottery built up along the curving rear edge.

The largest of the old sites (M1) is about a mile southwest of the station. It consists of 12 stone and whalebone house ruins about 400 yards back from the shore. The houses were built on old beach lines, the eighth and ninth up from the present beach, and at an elevation of approximately 75 feet above sea-level. Most of the M1 houses are better preserved than those at the Lake site; the pits are deeper, and many of the whale skulls, jaws, and other bones are still in position (Plates XI A, B; Plate XII A). The houses were of various shapes—oval-rectangular, bi-lobed, and tri-lobed; all had long, narrow entrance passages. House B, which appeared to be the oldest of the group, was partly excavated. This was a large house of several rooms with overall dimensions of 26 by 20 feet, exclusive of the entrance passage which extended down the slope for about 10 feet. A considerable amount of refuse was found around and in front of the entrance area, the midden extending for at least 30 feet beyond the entrance. This large accumulation of refuse indicated that House B, and others with similar middens adjacent, had been occupied for a considerable period of time. In addition to the typical stone and whale bone structures, there are several house ruins of another kind, appearing now only as slight depressions bordered by low banks of gravel. Two of these (Houses L and M) were excavated, one completely and one partially. They had stone floors and entrance passages but no roof beams or supports. They were probably autumn or summer houses, with roofs of skin.

About 280 yards to the south of M1 was M2, situated on the second old beach line about 20 feet above sea-level (Plate XIIB). The site consists

of a row of nine house sites like L and M—shallow, gravel-rimmed depressions with scarcely any whale bones or stones showing above the surface. To the west of these were numerous smaller depressions, stone-floored ruins, caches, and fireplaces. One of the houses, House A, was excavated and also a midden area in front of the houses.

Though the artifacts have not yet been studied in detail, they seem to show no significant differences, indicating that M1 and M2—and the Lake site as well—were contemporaneous. Indeed, it seems likely that M1 and M2 were occupied at different seasons of the year by the same people. M1, with its deep, solidly constructed houses, was probably the winter village, while M2, at a lower elevation and much nearer the sea, was occupied during the season of open water.

The fourth site, M3, is on the south side of Cape Martyr (Plate XIII). It consists of five underground house ruins like those at M2, but smaller, and in front of them a series of small stone-floored surface ruins. Only sample excavations were made at this site.

The houses at all four sites and the 1,100 specimens obtained from them are typically Thule. No trace was found of the Dorset culture. Many of the objects, particularly harpoon heads, are identical with types from Thule-Punuk sites in Alaska. This is also true of pictographic art. The incised pictograph of five men in a umiak harpooning a whale (Plate XVI Top), and several other examples showing geese and caribou are typically Alaskan in conception and execution, and nothing comparable to the whale hunt pictograph has previously been found so far to the east. However, this is not an imported piece from Alaska, for the figures are incised on a composite type of snow knife known only from the Central and Eastern Arctic.

Artifacts found at the Cornwallis sites include such Thule types as harpoon heads, foreshafts, socket pieces, finger rests, and wound pins (Plate XIV, figures 1-12); sealing scratchers, arrowheads (Plate XIV, figures 13-17); salmon spears, fish lures (Plate XIV, figures 20, 21); bola weights (Plate XIV, figures 18, 19); gull hooks, sled shoes, trace buckles (Plate XV, figures 12-14); snow knives (Plate XVI Top); snow shovels and probes, knife handles (Plate XV, figures 3, 5-11); drills, adze heads (Plate XV, figures 1, 2); picks, mattocks, cannon bone (Plate XV, figure 4) and scapula scrapers; soapstone, limestone, and pottery sherds (Plate XV, figures 15, 17); ivory combs and pendants (Plate XVI, figures 4, 8, 14); dolls, animal carvings (Plate XVI, figures 6, 7); fox and caribou tooth pendants (Plate XVI, figures 9-12); mica, pyrites, baleen knots and lines, sinew lines and thread, gut skin clothing, etc.

A striking feature at all of the sites was the paucity of stone implements. A few blades of rubbed slate and chipped stone were found, but far fewer than at most old Eskimo sites. Except for occasional igneous boulders of non-local origin, the only stone in the Resolute Bay area is limestone, a very poor material for making implements. The absence of suitable stone was no doubt partly responsible for the small number of stone implements; but the fact that a sizable Eskimo population lived here for a considerable number of years means that they had ready access to metal. A few small pieces of iron and copper were found at each of the sites, and we may assume from the size of the blade slits that many of the

knives and other implements were equipped with metal blades, as is so often the case at Thule culture sites. It is to be hoped that chemical or spectographic analysis may determine the source of the metal and thus help establish the age of the sites. In this connection it should be noted that some of the house ruins appear to be quite recent, with their pits little filled in and with walls and roof supports still in place. It is difficult to believe that such houses could be more than a few centuries old.

Animal bones from the old sites showed that seals had provided the principal food supply of the Cornwallis Eskimos. Next in importance as food animals were the bowhead whale and walrus. Considering the large number of implements that had been made of antler, there were surprisingly few caribou bones. Nor could musk ox have been very plentiful on the island, for very few bones were found. Polar bear bones were fairly numerous. Fox and dog bones were found in considerable numbers, especially the former. Bird bones were present but not numerous.

As the natural history of Cornwallis Island is little known, an attempt was made to collect representative samples of fossils, minerals, vascular plants, mosses and lichens, insects, and fresh-water invertebrates.

A. House B at Lake site before excavation.

B. House B at Lake site after excavation. Entrance passage in foreground.

A. House E, Lake site, before excavation.

B. House E, Lake site, partly excavated. Marker resting on stone floor. Sleeping platform at right. Entrance passage, excavation not completed, in foreground.

A. House C at site M1. Whale mandible roof supports still standing. Entrance in foreground, leading down slope.

B. House H at M1. Entrance passage in foreground. Fresh-water pond in rear.

A. House E at M1. Entrance passage, not visible, at right.

B. Site M2 on second old beach line up from present shore. J. P. Michea excavating at right (west) of House A. Midden area, partly excavated, in background.

A. House E at site M3 on south side of Cape Martyr.

B. Feather ornament; feathers fastened between strips of baleen. Found beneath stones supporting rear sleeping platform in House E, Lake site.

Plate XIV

Figure 1. Harpoon head, antler. Lake site, House B, depth 5 in.
" 2. Harpoon head, antler, M1, House B, depth 9 in.
" 3. Harpoon head, antler. M1, House B, depth 4 in.
" 4. Harpoon head, antler. M1, House B, depth 7 in.
" 5. Harpoon head, bone. Lake site, House I, depth 4 in.
" 6. Harpoon head, bone. Lake site, House B, depth 10 in.
" 7. Harpoon socket piece, bone. Lake site, House B, depth 2 in.
" 8. Harpoon foreshaft, bone. M1, House B, depth 5 in.
" 9. Harpoon finger rest, ivory. M1, House B, depth 5 in.
" 10. Harpoon finger rest, ivory. M2, midden, depth 5 in.
" 11. Harpoon finger rest, ivory. Lake site, House B, depth 3 in.
" 12. Wound pin, antler. M2, midden, depth 5 in.
" 13. Arrowhead, antler. Lake site, House I, depth 4 in.
" 14. Arrowhead, antler. M1, House B, depth 3 in.
" 15. Arrowhead, bone. M1, House B, depth 3 in.
" 16. Arrowhead, bone. M1, House B, depth 2 in.
" 17. Arrowhead, bone. M1, House B, depth 3 in.
" 18. Bola weight, bone. M1, House B, depth 4 in.
" 19. Bola weight, bone. M1, House M, depth 24 in.
" 20. Fish lure, bone. M1, House B, depth 5 in.
" 21. Fish lure, bone. M2, House A, depth 3 in.

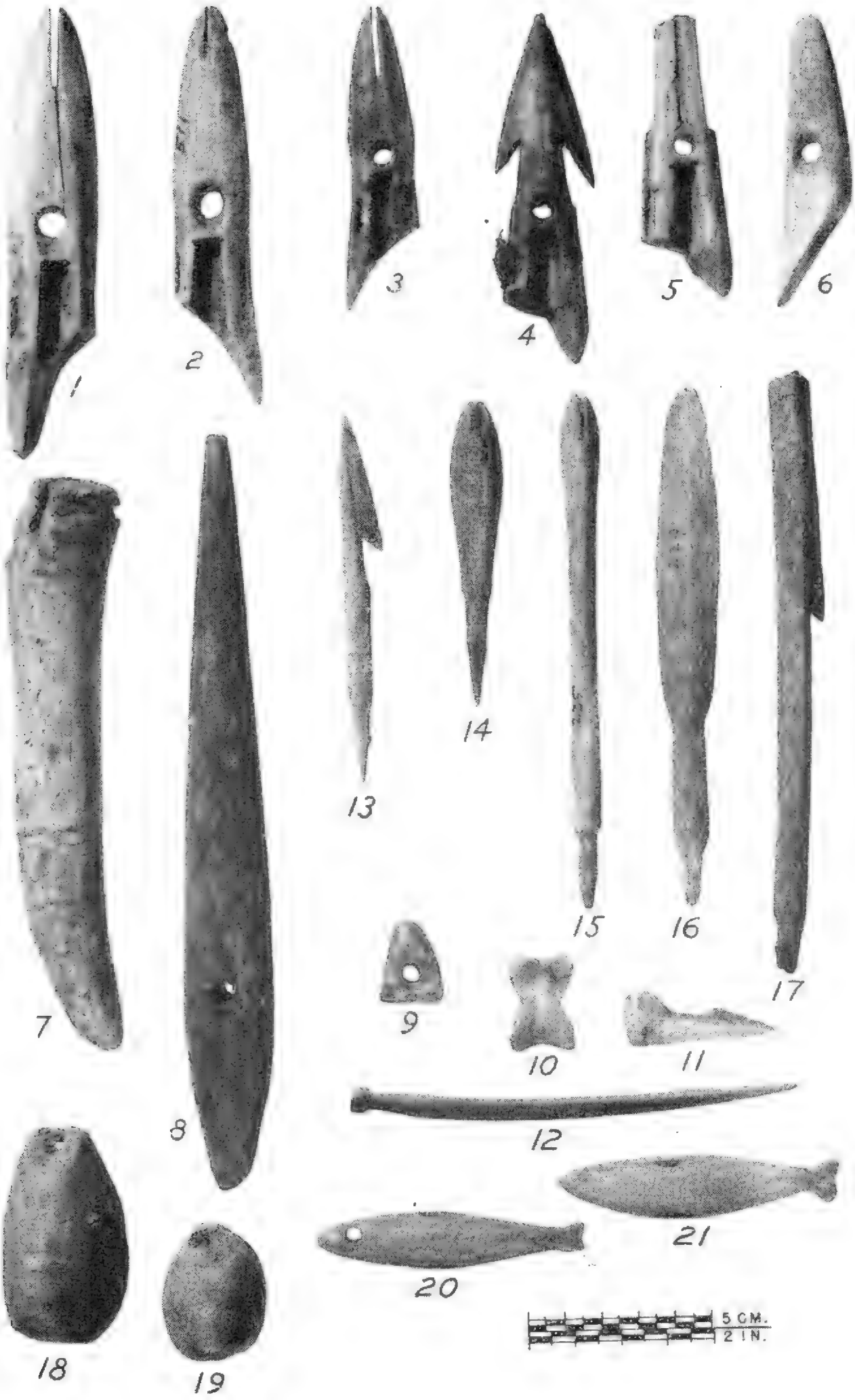
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Plate XV

Figure 1. Adze head, bone. Lake site, House B, depth 8 in.
" 2. Adze head, bone. M1, House B, depth 4 in.
" 3. Knife handle, antler. M1, House B, depth 3 in.
" 4. Scraper, caribou leg bone. Lake site, House B, depth 8 in.
" 5. Knife handle, bone. M2, midden, depth 3 in.
" 6. Knife handle, antler. Lake site, House B, depth 9 in.
" 7. Knife handle, antler. Lake site, House E, depth 2 in.
" 8. Ulu handle, antler. M2, House A, depth 12 in.
" 9. Ulu handle, bone. Lake site, House B, depth 6 in.
" 10. Ulu handle, bone. Lake site, House B, depth 7 in.
" 11. Ulu handle, bone. M1, House L, depth 13 in.
" 12. Trace buckle, bone. M1, House B, depth 3 in.
" 13. Trace buckle, bone. M1, House B, depth 4 in.
" 14. Trace buckle, antler. Lake site, House I, depth 5 in.
" 15. Limestone sherd. M1, House B, depth 8 in.
" 16. Copper harpoon blade. Lake site, House B, depth 5 in.
" 17. Soapstone sherd. M1, House B, depth 3 in.


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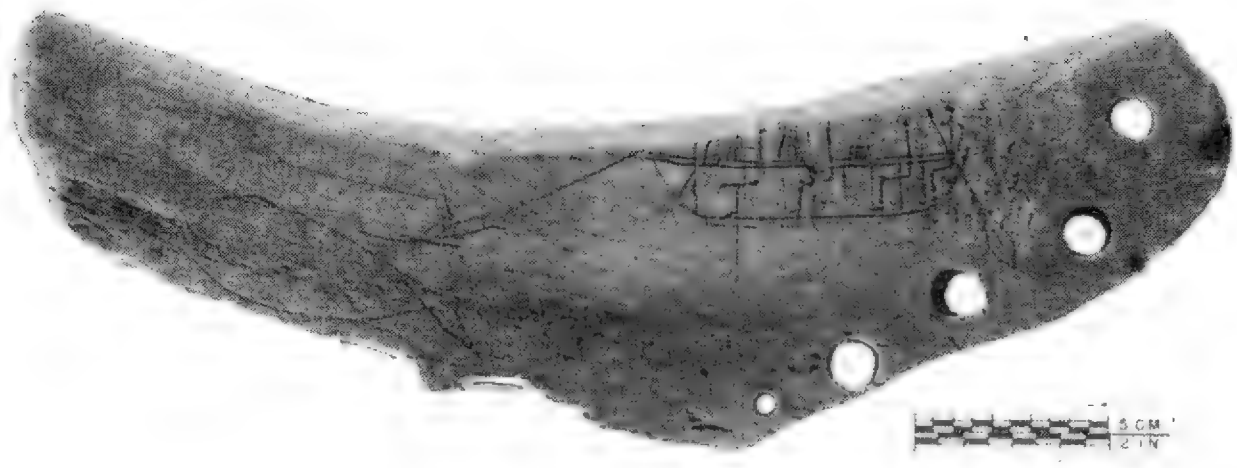
Plate XVI

(Top)

Piece of whale bone snow-knife handle with incised pictograph of five men in umiak harpooning a whale. Found at Lake site, House B, depth 7 in.

(Bottom)

Figure 1. Throwing board or sling handle, wood. M1, House B, depth 8 in.
" 2. Handle, antler. M2, House A, depth 6 in.
" 3. Antler object. Lake site, House I, depth 8 in.
" 4. Ivory comb. M2, House A, depth 15 in.
" 5. Ivory thimble guard. M2, House A, depth 5 in.
" 6. Polar bear, ivory. Lake site, House B, depth 5 in.
" 7. Cord handle, ivory. Lake site, House B, depth 10 in.
" 8. Link ornament, ivory. Lake site, House B, depth 4 in.
" 9. Fox tooth pendant. M1, House B, depth 7 in.
" 10. Fox tooth pendant. M1, House B, depth 7 in.
" 11. Fox tooth pendant. M1, House B, depth 7 in.
" 12. Caribou tooth pendant. M1, House B, depth 7 in.
" 13. Ivory object. M2, House A, depth 4 in.
" 14. Ivory pendant. Lake site, House B, depth 8 in.



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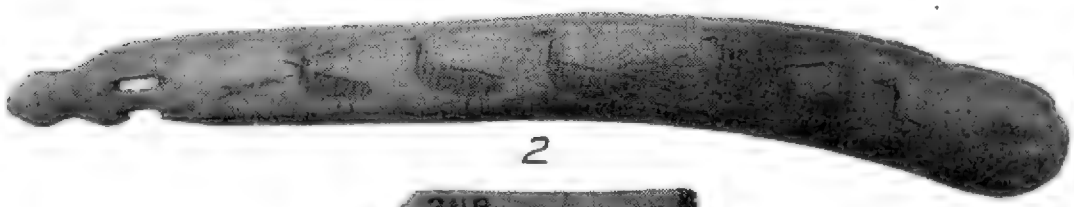

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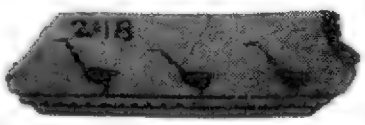

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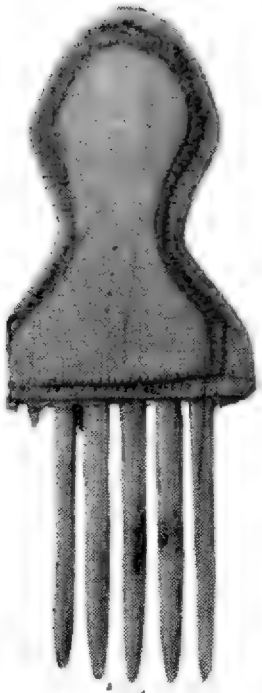

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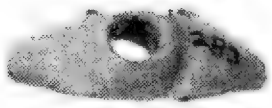

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A MIXED CAPE DORSET–THULE SITE ON SMITH ISLAND, EAST HUDSON BAY

By T. H. Manning

The following notes[1] are based on information and specimens collected by members of the Geographical Bureau's expedition while storm-bound near the eastern end of Smith Island on August 6, 1949. The principal object of the expedition was to investigate islands in Foxe Basin which had been recently mapped from air photographs. On July 8, the party, which consisted of T. H. Manning, leader; D. B. Coombs, C. Merrill, and R. W. Packer, geographers; W. K. W. Baldwin, botanist; C. A. Burns, geologist; and A. H. Macpherson, cook, left Moosonee on the C.G.M.V. *Nauja*, a specially built Peterhead boat. During the summer about 4,000 miles were logged, and numerous landings made for scientific work in Hudson Bay and Foxe Basin before finally docking at Churchill on October 5.[2]

Smith Island lies on the east coast of Hudson Bay about 70 miles southeast of Mansel Island and some 120 miles south of the west entrance to Hudson Strait. It is about 12 miles long in a northeast-southwest direction, less than 4 miles wide at its greatest width, and is separated from the mainland by a narrow island-filled channel. Near the northeast point of Smith Island, about midway between the extreme point and the chain of barren lava hills which form the backbone of the island, are about twelve moderately well-preserved Eskimo stone house ruins. Most of the houses are in a semicircular row, about 50 feet above high tide line, and an estimated 500 yards from the east shore of the island; 15 to 20 feet lower are three other houses of apparently similar age. Twenty feet or so from the back of the main row, and about 5 feet higher, are a number of circular hollows, which at first were considered to be older houses from which most of the rocks had been removed when the new houses were built. Surrounding the more obvious of these hollows could still be seen a low ridge of gravel. The entrance was usually marked by a gap in the ridge and a shallow trench. Part of the turf covering the wall and centre of one of these hollows was removed, revealing gravel and a few small rocks below it. No artifacts were found in the turf or near the surface of the gravel; and, as the permafrost would have prevented anything like a complete excavation, no further digging was done.

Between these apparently older houses and the younger were some slight elevations. One of these was uncovered and proved to be a bone midden. It was dug to the permafrost, which was there about 10 inches below the turf. No artifacts were found. Since these middens lie behind the newer houses but are in the natural place where rubbish would have been thrown from the doors of the structures now represented by the hollows, it appears almost certain that the middens were formed by the inhabitants of these places and not by those of the newer houses in front.

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[1] Mr. Graham Rowley and Dr. Douglas Leechman kindly read the MS. and made helpful suggestions.

[2] A more detailed account of the expedition is given on p. 162 of this report and in Manning 1950a, b.

Old Eskimo dwellings on Smith Island viewed from the north. The arrow points to the house which was partly excavated. To the right of that house can be seen one of the circular hollows referred to in the text. (D. B. Coombs photo)

The bones which composed the middens appeared far too well preserved, however, for the apparent age of the hollows, if these hollows are assumed to have been remnants of houses of the Thule type.[1]

A possible explanation is that these hollows are not the remains of winter houses but are homologous with strong tent rings and have never had more than low, gravel walls upon which skin tents were erected in the summer.[2] This hypothesis would explain (1) the existence of a midden of well-preserved bones outside some apparently

PLATE XVIII

The house before excavation. (Neg. No. 13-6-49.)

very old houses; (2) the actual formation of a bone midden which would not be expected in winter, when dogs scatter bones over a wide area, but which might well form in summer if the dogs had been put out of the way to fend for themselves, as is frequently done by modern Eskimos, on one of the small islands between Smith Island and the mainland; (3) the large number of artifacts found in or below the turf of the back wall of the house excavated and which could have been left there by people living during the summer in tents behind the house.

[1] It is of course true that after the wall rocks, roof supports, and other materials had been removed, decay would have been rapid.

[2] Similar hollows were associated with the Cape Dorset find at Abverdjar (Rowley, 1940, p. 491), and Leechman (1943, p. 366), who excavated other hollows at Nuvuk Island, observed traces of walls in only two out of nineteen.

About half a mile east of this group of houses was a grave containing parts of a poorly preserved skeleton. Some of the long bones were collected. There was no skull or grave furniture, but the remains of a skull were found a little way off. Both in the area of this grave and about a mile south along the coast from the houses were many caches of varying age, a few still being in use.

One side of one of the youngest single-roomed houses was excavated as far as the permafrost would permit in a single day's digging. The edge

PLATE XIX

The same ruin of the house during excavation. (Neg. No. 13-12-00.)

of the bed on this side was exposed for about a foot inwards, and the vicinity of the meat and lamp table was almost completely dug, but most of the specimens described below came from the outer side of the wall. There was very little roof debris in this house compared to houses at Nuwata and on Southampton Island. This may imply that it was roofed with skins or driftwood, the latter being comparatively common on the east Hudson Bay Coast. Only a few such pieces of wood were found in the houses, and the only whalebone was a single vertebral disk.

DESCRIPTION OF SPECIMENS

Harpoon Heads. No. 15.–Two inches below wall turf. A Thule type 3 (A1C1) (Mathiassen 1927b, p. 18) harpoon head of antler. The side opposite the shaft socket is flattened, and the lashing slots converge toward that side. There is a distinct lateral constriction between the line hole and the lashing slots. No. 5.–Just under wall turf and within a few inches of a drilled tooth. No. 13.–At the surface of the gravel, 10 inches below wall turf. Nos. 5, 2, and 13 are type 5 (Mathiassen, 1927b, p. 28) Cape Dorset harpoon heads. Both are of antler; both have one side of the blade socket broken.

Harpoon Fore-shaft Socket. No. 19.–From interior of house near the lamp table. Half (broken longitudinally) a solid type, Thule socket-piece of antler, with a drilled flange at the back end. It resembles some of the hollow types illustrated by Mathiassen (1927a, Plate 3) in having a lashing groove at the fore-end to prevent splitting.

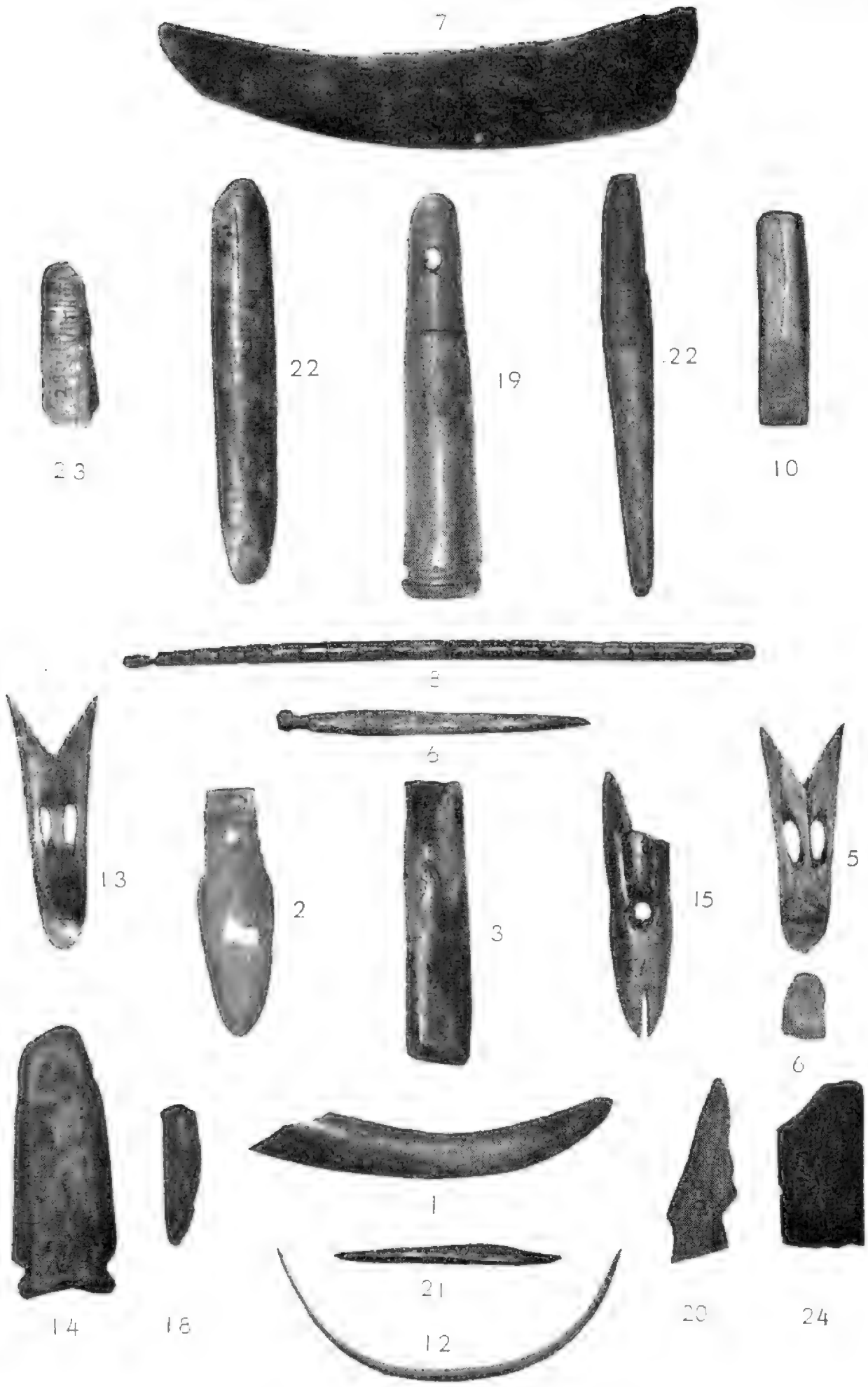
Ice Pick. No. 22B.–From just below wall turf. An ice pick of antler slightly flattened on one side. Its upper end has been roughened on both sides by transverse cuts to provide a grip for lashing and scarfing to the harpoon butt. This is a common and widely distributed implement in the Thule and modern cultures (Mathiassen 1927b, p. 35).

Stone Blades. No. 2.–From the lower side of wall turf. A lance blade of red slate containing small specks of pyrites. One surface of the blade has been ground to leave a distinct median line; the other is more rounded. The tang is brought to a screw-driver edge by a triangular-shaped facet. The notches on the tang have been ground out. There are five on one side and six on the other. No. 14.–A double-edged knife blade of grey-green slate, with a blunt, rounded point, and edges formed by equal grinding on both surfaces. The notches have been ground out. Jenness (1941) describes similar specimens from the Belcher Islands and associates the notched base with the Dorset culture. No. 24.–In wall turf. Part of a single-edged knife blade of black slate. Both sides of the blade have been ground flat. On one side, the bevel begins 11 mm. from the edge and steepens 3 mm. from the edge; on the other side, only the final steep bevel is present. No. 20.–From inside house near table. A small, crooked knife of grey quartzite, resembling the crooked or curved flint and quartz knives of the Cape Dorset culture (Jenness 1925, p. 432; Mathiassen 1927b, p. 75). Like the similar knives found by Leechman (1943, p. 370), one face shows the original, unaltered fracture plane.

Knife Handle. No. 3.–Four inches below wall turf. A knife handle of antler similar to Mathiassen's type 2D, of which fifteen specimens were found at Naujan (1927a, p. 51). It consists of a piece of antler with an irregular rectangular cross-section and rounded edges. At one end there is a rectangular socket (15 mm. by 3 mm.) which contains a small piece of iron. Analysis at the National Museum of Canada showed that this iron, as well as that from the drill-shank (see below) contained more nickel and cobalt than is normal in commercial iron. Both pieces were probably of meteoric origin.

Wound Plugs. No. 16.–Bottom of turf. No. 21.–Near the lamp table. Both are slightly flattened on one side. No. 16 is irregularly oval in cross-section; No. 21, which might have been used for another purpose,

PLATE XX



Artifacts obtained from Smith Island Site.

is more nearly round, and most of its head, which appears to have been small, is now broken away. They resemble wound plugs from Naujan (Mathiassen 1927a, p. 34) in having a distinct shoulder below the head.

Wedges. No. 10.–In turf. A wedge of antler slightly flattened on both sides. No. 22A.–From just under wall turf. Possibly a wedge of whalebone with one convex and one flat side. The upper end is slightly waisted laterally, possibly to fit the hand. It might have been used as a boot softener.

Knife-like Fragments. Nos. 17, 1.–Both just below turf. No. 17 is a longitudinal section of walrus tusk resembling the snow knife fragment from Cape Dorset illustrated by Jenness (1925, fig. 6Q). One surface is flat and appears to have been rubbed smooth after cutting; the other is slightly rounded and is perhaps the natural worn surface of the tusk. No. 1 is a longitudinal section from the tip of an antler. One side is again smooth and flat and the other unworked. Its use is uncertain.

Drill Shanks. No. 18.–In turf. Lower part of drill shank made from an antler tip. The upper end is roughly triangular and tapered. One side, presumably where it was scarfed to the upper part of the shank, is more flattened. The upper part is roughened by transverse cuts on all three sides. The remains of a piece of iron was embedded in the bottom end of the shank. Mathiassen (1927a, p. 57) obtained a similar specimen from Naujan.

Ornaments. No. 12.–A brow band formed from a thin, curved piece of antler 12 mm. wide at the centre and tapering gradually to the ends where there are small drilled holes. Along the median line of the front surface at approximately 13 mm. intervals are small drilled indentations. Two somewhat similar brow bands are described by Mathiassen (1927a, pp. 73, 186) from Thule sites: one from Naujan and one from Qilalukan. No. 8.–In wall turf. An ivory rod tapering toward one end where it is bluntly pointed. The other end is blunt and irregular. One side is rounded and ornamented at regular intervals with grooves which are continued round the flattened edges and are faintly marked on the opposite surface, where there is a longitudinal ridge about 3 mm. wide and 1·5 mm. high. At each end of the rod and also at two-fifths of the way from the blunt end is a small hole drilled in the ridge. Mathiassen (1927a, p. 172; 1927b, p. 79) has tentatively identified a similar object as the bow of a bow drill, but in the present specimen the smallness of the holes, the third hole near the middle, and the asymmetrical ends make such a use improbable.

Other Objects. No. 6.–In turf. A small piece of ivory, possibly an unfinished finger-rest for a harpoon. No. 23.–In debris 8 inches above bed. A broken piece of whalebone with a roughened surface for lashing. Possibly an ice pick. No. 25.–A small whale rib, probably used for prying out rocks. One end has been roughened for the hand grip, the other cut flat on the convex side to form a chisel edge which is now very worn.

CONCLUSION

Only four specimens were obtained from the interior of the house, the remainder were either in the turf covering the wall immediately below the turf or somewhere within an average of 10 inches of humus

material which lay between the turf and the gravel that formed the main part of the wall. Most of them were near the top of the wall, as it existed when we began to excavate, and it is possible that the specimens found at the deeper levels had fallen through cracks when the roof collapsed. There is nothing in the appearance or type of the deeper specimens to suggest that they are older than those near the surface. Cape Dorset and Thule types are mixed both in and outside the house, and it seems probable that some Cape Dorest traits survived in this region and on the Belcher Islands into Thule times (cf. Quimby 1940, p. 148), but Cape Dorset harpoon heads have not previously been reported south of the pure Cape Dorset site excavated by Leechman (1943) at Nuvuk. Whether the two Cape Dorset harpoon heads found on Smith Island were made by the same people who made the drilled Thule implements with which they were associated, or whether the Thule people had picked them up from an older site, cannot be determined until more work has been done in the area. The Thule harpoon head is certainly much better preserved than are the two Cape Dorset heads, but this might be due to a difference in the antlers from which they had been made.

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PERSISTENCE OF A TUTELO CULTURAL TRAIT AMONG CONTEMPORARY CAYUGA OF GRAND RIVER, ONTARIO

By Marcel Rioux

The following is a brief report of a Tutelo ceremony which Joseph Martin of Laval University and the writer had the privilege to attend while making an anthropological survey for the National Museum of Canada at the Six Nations Iroquois Reservation.

In his book entitled "The Tutelo Spirit Adoption Ceremony,"[1] the late Dr. Frank G. Speck has fully described the Redressing Ceremony itself. The present article deals with a complementary rite which Dr. Speck does not describe in his above-mentioned essay. The aim of the Adoption Ceremony itself is outlined by Deskáheh, a Cayuga chief who conducted the rituals at the ceremony Dr. Speck attended on December 31, 1938. "You know," said Deskáheh on that occasion, "that certain people known as Tutelo have carried this Great Feast down from far back in the past to the present, since the Cayuga became allied with the Tutelo. The two tribes have co-operated in this their ceremony. So when the Tutelo, as we are told, realized that their race was decreasing in numbers they begged of the other nations the privilege of adopting them to replace their deceased relatives, by substituting others who are living in their place." It was around 1753 that the Tutelo, an Eastern Siouan tribe, was admitted to the Iroquois League of Nations and was officially adopted by the Cayuga. This adoption meant, according to informant Pat Longboat, that the Tutelo were to be considered as being equal with the Iroquois and that from then on they were full members of the Iroquois family. History proves that the Cayuga were sincere: the Todiihōnon (Tutelo in Cayuga) have always been treated fairly by the Iroquois and have been allowed to preserve some of their customs.

If some of the meaning of these ceremonies has been lost by the actual Cayuga bearers of this tradition, the purpose of the ceremony itself seems clear in most of the minds of the participants. As Dr. Speck writes, "The avowed purpose of the Adoption Ceremony is to bring back the soul of a defunct Tutelo tribe member who has died recently, within approximately a year, into association with the living for the space of one night." It is to be observed, however, that this ceremony can only take place in the winter while the vegetation is dormant, so that the ghosts which come back on earth for that "feast" do not affect the crops. When death occurs in summer, the Adoption Ceremony is postponed until the following winter, and a ceremony is performed on the fourth night after the decease; the purpose of this first ritual is to let the deceased person and his relatives know that the Adoption Ceremony will take place later.

The occasion of the ceremony described below was the death of George Williams, a member of the Onondaga tribe who had previously been adopted to replace a person of Tutelo descent. Mr. Williams died on a Friday and was buried in the Long House on the following Sunday. The relatives of the deceased asked Albert Thomas, a singer of the Handsome

[1] Speck, Frank G. "The Tutelo Spirit Adoption Ceremony, Reclothing the Living in the Name of the Dead," Pennsylvania Historical Commission, Harrisburg, 1942.

Lake persuasion, to conduct the ritual the following day. He immediately got in touch with nine "helpers" and summoned them to be present at the house of Bill Thomas, a cousin of the deceased, where the ceremony was to be held.

White people are not ordinarily allowed to witness these ceremonies; special permission was granted to Mr. Martin and the writer by the relatives of Mr. George Williams and the Leader of the Onondaga Long House. We were told to be there as soon as the sun had set. People began to arrive soon after and gathered outside the House. Their attitude was of sorrow and mourning; they spoke in undertones and waited patiently for the opening of the "feast," which did not start before 11 o'clock. A light meal was served first. The leader then gave the signal to enter the house. When we came in, silent men and women were already sitting in a large room; on the table were pies, cakes, and loaves of bread. We were led into another smaller room where the singers and the drummers were already seated. On a bench near the wall were five singers with the head-drummer in the centre; at his right, the head-helper with his horn rattle was seated. Facing them on another bench were the other five "helpers"; the oldest one was sitting in the centre, facing the head-drummer. On another bench behind the benches of these singers, near the other wall, four women were seated; they were the silent mourners. When all had taken their places, one of the singers stood up and delivered a speech in Cayuga. He told the purpose of the ceremony, namely, to let the deceased person and his close relatives know that next winter he would be replaced by somebody else. He then asked all the people outside to come into the house to attend the ceremony. He warned the persons present to notice immediately if a woman were to sing, because this would mean that somebody in the audience would die soon. He concluded his opening remarks by asking all the people present in the house not to leave before the end of the ceremony. After this speech, the oldest helper walked to the stove and threw in four pinches of Indian Sacred tobacco. He then came back to his seat and put some tobacco in front of each singer. The leader, accompanying himself with a water-drum, started to sing. The songs, restricted in melody and rhythm, were grouped in series of four which were each sung four times by the head-drummer and the "helpers." After sixteen songs had been sung, there was an intermission of two or three minutes. Before chanting was resumed, the oldest helper distributed tobacco to every one of the singers. The pattern was always the same for the six series of four songs each, which were sung four times. Any error made in the sequence of these 96 songs[1] was corrected by the offering of sacred tobacco. During the ceremony we witnessed, two or three errors were made, whereupon the man at fault was given some tobacco by the "tobacco-keeper."

When the singing was over, the food that had remained on the table in the other large room during the ceremony was distributed to singers and relatives and wrapped in handkerchiefs distributed for that purpose.

As a general remark, it is to be observed that this particular Tutelo ceremony is performed in the same spirit as the Cayuga ceremonies themselves. The ritual which begins in deep sorrow ends in a gay mood. As informant Pat Longboat stated, a feast for a deceased person should

[1] They have been subsequently recorded for the National Museum of Canada.

always end with the thought that the living still have to live and that the Great Spirit should be thanked for preserving the life of the other members of the community. The food that is distributed at these feasts for the dead is a mark of respect for the gifts that the Great Spirit has bestowed upon his children. At every ceremony, not only our spirit should participate but also our body; the best way to make the body participate is by distributing the food that the Great Spirit has given to men for the purpose of strengthening their bodies so that the spirit (the heart) may be strong.

FOLK AND PRIMITIVE MUSIC IN CANADA

By Margaret Sargent

Within her three and a half million square miles, Canada possesses a wealth of primitive and folk music. In order to facilitate future research the following notes have been prepared regarding the progress that has been made so far in this field.

HISTORICAL SUMMARY

Although the existence of Canadian Indian music has been recognized for several centuries, our early records of it come solely from explorers who jotted down fragments haphazardly in their journals. The first among them was Marc Lescarbot, a young French lawyer. During an early expedition to Port Royal, he wrote out four Micmac songs in the tonic sol-fa (do, re, mi. . .), which were published in 1609 in his *History of New France.* In 1635, they were republished by Sagard in his *Histoire du Canada et Voyages.*

PRIMITIVE MUSIC

It was not until 1898, however, 289 years after the appearance of Lescarbot's book, that a collection, adequate for study purposes, was first published. In that year, the Ontario Archæological Report included the music and explanations for thirteen Seneca Songs, prepared by the musician, Alexander Cringan, from the singing of Ka-nis-han-dan, a Seneca chief of Grand River, Ontario. The interest aroused by their appearance resulted in the printing of eighty-one additional songs, in the Reports for 1899 and 1902. Nothing further was done until 1910 when a systematic collection of primitive music was undertaken by the Anthropological Division of the National Museum of Canada.

The records amassed by the National Museum, from 1910 to the present day, constitute the largest individual collection of native music in America. The work was initiated by Edward Sapir, who, in that first year, recorded with an Edison phonograph one hundred Nootka songs on the west coast of Vancouver Island. Its full development, however, was largely due to the zeal and energy of the anthropologist, Marius Barbeau. Besides contributing personally to its expansion from 1911 on, he has influenced the work as a whole by inspiring the efforts of such collectors as James Teit, W. H. Mechling, A. B. Regan, W. D. Wallis, J. A. Mason, and Cornelius Osgoode. Independent workers, D. Jenness and Christian Leden among the Central and Eastern Eskimo, T. F. McIlwraith among the Bella Coola, and Catharine McClellan and Dorothy Rainier among the Tlingit of the Yukon, have added substantially to this collection.

The Museum now has 2,631 recordings of Indian songs which represent virtually every Indian tribe in Canada. Their value rests largely upon the fullness of their documentation. The tunes were supplemented by the phonetic recording of the texts, first in the native language, then with literal translations and other annotations.

A small part of this material has been prepared for publication and used in *Songs of the Copper Eskimos*, by Jenness and Roberts, and Barbeau's *Songs of the Northwest, Asiatic Survivals in Indian Songs*, and

Tsimsyan Songs (still in manuscript form at the American Ethnological Society, New York). A large part still awaits study. The following is the complete list:

Nation (grouped according to cultural area)	*Number of Songs*	*Number of cylinders*	*Collector*	*Year*
EASTERN WOODLANDS				
Huron-Wyandot	562	157	Barbeau	1911–12
Iroquois	465	130	Barbeau	1912, 1949
	15	on magnetic tape	M. Sargent	1949
Cree	21	17	Teit, Osgoode	1915, 1928
Ojibwa	37	65	Regan	1913, 1915
Malecite	49	48	Mechling, Barbeau	1911
Micmac	3	1 disk	Cassidy	1947
ARCTIC				
Alaska Eskimo	3	1	Jenness	1915
Central Eskimo	171	124	Leden, Jenness	1914–15
Mackenzie Eskimo	17	8	Mason, Jenness	1913, 1915
Siberian Eskimo	3	2	Jenness	1915, 1916
PLAINS				
Crow	1	1	Teit	1914
Sarcee	90	45	Jenness	1921
Shawnee	2	2	Barbeau	1911
Sioux	65	45	Wallis	1914
PLATEAU AND MACKENZIE				
Carrier	21	17	Teit, Barbeau	1918, 1920
Chipewyan	11	8	Mason	1913
Dog-Rib	79	30	Mason	1913
Hare	29	29	Osgoode	1928
Loucheux	15	13	Mason	1913
Sekani	54	44	Teit, Mason	1912–13
Slavey	23	11	Mason	1913
Tahltan	90	86	Teit	1912, 1915
Yellow-Knife	17	7	Mason	1913
Chilcotin	3	3	Teit	1915
Kootenay	3	3	Waugh, Teit	1916
Lillooet	16	16	Barbeau, Teit	1912,1915, 1918
Okanagan	28	28	Teit	1916
Shuswap	11	11	Barbeau, Teit	1915,1918
Thompson River	219	216	Barbeau, Teit	1916,1918, 1921
NORTH PACIFIC COAST				
Bella Coola	118	59	McIlwraith	1924
Haida	8	8	Barbeau	1947
Nootka	104	85	Sapir, Teit	1910, 1918
Salish	8	8	Sapir	1913
Tlingit	3	3	Teit	1915
	5	on disks	McClellan and Rainier	1949
Tsimsyan	261	187	Teit, Barbeau	1915,1920, 1926–27

FOLK MUSIC

The first folk music to elicit attention was French-Canadian, perhaps because its lilting melodies fall so pleasingly upon the ear. The first collection of these to be published was *Canadian Airs, collected by Captain Sir George Back, during the Arctic Expeditions under Captain Sir John Franklin,* issued in 1823. Seven years later, in 1830, Edward Ermatinger wrote down with words and tunes eleven voyageur songs of the Northwest. As early as 1863 an article on French folk songs appeared in *Le Foyer canadien,* and in 1865 Gagnon's well-known *Chansons populaires du Canada* was published.

Systematic collecting was not undertaken until 1915 when Marius Barbeau began collecting French-Canadian folk songs for the National Museum, a work which now has grown to a vast extent. Two evening programs selected from this music were presented in 1919 with both folk and concert artists at the Bibliothèque Saint-Sulpice in Montreal. Later, from 1927 to 1930, three successful Folk-Song and Handicrafts Festivals were held at the Chateau Frontenac under the sponsorship of the National Museum and of the Canadian Pacific Railway. As a further outcome, several books of folks songs were published, with accompaniments by such Canadian musicians as Achille Fortier, Alfred La Liberté, Ernest MacMillan, Healey Willan, Leo Smith, Oscar O'Brien, and Alfred Whitehead.

The impetus given by these events has lasted to the present day. Collections are being continued; many books, both of songs and studies, are appearing; whilst throughout the entire country the lively strains of this folk music, sung by French- and English-Canadian alike, may often be heard.

During the early part of the twentieth century, when Indian and French-Canadian songs were already being sought by determined collectors, the existence of Canadian folk music of English, Scottish, and Irish origin was scarcely known. A handful of songs, foreshadowing the rich harvest to be gathered, had already appeared in the early issues of *The Journal of American Folk-lore.* But it was not until 1919, when Roy Mackenzie tracked down the folk songs in his native Nova Scotia and embodied them in his book *In Search of the Ballad,* that their existence was fully realized.

Even when this had come about, detailed collecting was slow to follow. Roy Mackenzie published a second book, *Ballads and Sea Songs of Nova Scotia;* Helen Creighton followed up his work with *Songs and Ballads of Nova Scotia;* the English collector, Maud Karpeles, and the Americans, Elisabeth Greenleaf and Grace Mansfield, sampled the folk-song treasures of Newfoundland, their results appearing in *Folk Songs from Newfoundland* and *Ballads and Sea Songs from Newfoundland.* Private individuals, such as Louise Manny, M. M. MacOdrum, and Mr. and Mrs. Lorne Campbell, collected material in the Maritimes, as yet unpublished. Beyond this, little was done for many years. In 1947, after Helen Creighton had spent several years collecting Canadian folk songs for the American Library of Congress, the National Museum engaged her as a folklorist for field work, and she has collected a great quantity of material. The wealth of material in other parts of Canada, particularly in Ontario, the Prairie Provinces, and British Columbia, is still practically untouched.

PART PLAYED BY THE NATIONAL MUSEUM

The importance of the work that the National Museum has been doing in preserving and distributing Canadian folk music has increased with the years. From 1910 to 1949 the Museum strove principally to preserve music which was rapidly vanishing because of the popularity of the phonograph, the motion picture, and the radio. Now the music that originally came from the people is being put back into circulation.

The work as carried on at present includes: (1) the transference of past collections from perishable wax cylinders to magnetic recording tape, (2) the transcription of tunes, and (3) the collection of folk songs.

This year, five hundred Huron-Wyandot and Iroquois songs were transferred to magnetic tape from perishable wax cylinders. An equal number will be put on tape each year until the entire collections of French and Indian music are transferred. The new recording tape, developed for commercial use since World War II, simplifies transcription by increasing to a marked degree the volume and tone quality of the music. Of even greater importance is the assurance that the tape will last indefinitely when stored under conditions similar to that used for motion picture films.

Music must be transcribed from record to musical staff to be made generally available. Transcriptions should conform to our modern musical notation, augmented by extra signs indicating deviations beyond our musical experience. When this is done, the average reader with a knowledge of music may expect to reproduce it with reasonable accuracy. Numerous songs, both Indian and English-Canadian, have been transcribed by the writer during the past year. Some Iroquois-Huron songs are being included in a book entitled *Old-World Dragon on the Great Lakes*, by Dr. Barbeau and the author; others have supplied themes for a children's suite for piano, by Kenneth Peacock, first Canadian composer to have music recorded commercially in Great Britian; a song-book of English-Canadian folk-songs is being prepared by the Museum.

During the past year, outside contacts have been numerous. Iroquois music was recorded on magnetic tape to assist in the preparation of a film on the False-Face and Rain Dances of the Iroquois, by the National Film Board. A Museum lecture was given to the children of Ottawa, showing the collecting of folk songs, their use by the children themselves, and films incorporating them. Both Alan Mills and Edith Fowke of the C.B.C. have visited the Museum to examine the collections and to discuss the possibility of broadcasting the best samples over the radio, Mr. Mills as a singer of folk songs and Mrs. Fowke as a program director. Numerous requests for material from graduate students have been granted; to the musicologist, Miss Andrée Desautels, who is to lecture on Canadian music at the University of Neuchatel, recordings of Indian, French-Canadian, and English-Canadian music have been given, together with all existing information.

This is merely a beginning. The Museum hopes eventually to supply material that will contribute to the findings of ethnologists and social anthropologists; to distribute music for entertainment through closer contact with the National Film Board and the Canadian Broadcasting Corporation; to spread folk songs across the country in song books; to collect and publish folk dances. In short, its work cannot fail to make a rich contribution to Canadian life and culture.

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THE RAVEN, FROG, AND BEAR TOTEM POLE

A Masterpiece of Haida Art

By Josephine Hambleton

There exists no other sculpture quite like the Raven, Frog, and Bear totem pole. It is the last, most romantic expression of Haida art. The animals are symbols for the divinities who, the Haidas believed, sometimes protected and sometimes wantonly destroyed their lives. It illustrates that sense of mystic affinity which this gifted people felt with the natural universe; and though the characters are the conventional ones which native artists had used for generations, the graceful manner of their grouping on the pole reflects the genius, the individuality of the carver, Isaac Chapman, and the final phase of Haida sculpture. It was an art that would inevitably have become over-refined without Chapman's influence, but the humiliations and sorrows of his brief life so intensified the romantic quality of his genius, that he transformed that refinement into a beauty no other Haida artist could express.

The Raven, Frog, and Bear totem pole was Isaac Chapman's masterpiece. Carved from argillite, a slate found on the Queen Charlotte Islands, the pole measures 25 inches high and belongs to the Prince Rupert Museum in British Columbia. The figures from the top down are: Frog; Raven and, in his beak, Eagle; Pee-sunt, the Indian maiden and her semi-divine children, half-bear, half-human; Beaver, gnawing his poplar stick; and Raven.

Frog symbolized Dzelarhons, bride of a Grizzly-bear chief. Married to unite the destinies of her own Eagle people with those of the Grizzly-Bear clan, she experienced bitter humiliation. To avenge her, the Eagles invaded the Grizzly-Bear camp, but she had vanished. In Haida tales, she appears now as Volcano Woman, now as Frog. Frog punishes cruelty to animals, as Grizzly Bear chastises blasphemy.

Blasphemy was Pee-sunt's crime. Returning home with friends from a berry-picking expedition one day, she strayed from the path. Her pack-strap broke, and, impatient with the delay, she swore. Two youths offered to help, but before she realized her predicament, they carried her off to the Grizzly-Bear camp, where she was forcibly married to the nephew of the chief. Eventually she bore her husband two sons, half-bear, half-human. Meanwhile her family were continuing their search for her and eventually killed her Grizzly-Bear husband. Ever after, her descendants practised rites to honour the Grizzly-Bear gods.

Although Frog and Grizzly Bear symbolized a sort of primitive moral code, Raven was considered the father of mankind and their teacher. Beaver made his task very difficult, because he hoarded all fish. One day, while Beaver was away, Raven stole his hoard, rolled up Beaver's house and dam, and flew away. Wherever he saw a river, he dropped a few fish which multiplied and gave people food, and wherever he saw people, he gave them the house and dam to show them how to build for themselves.

(Left) Raven, Frog, and Bear Totem Pole, by Isaac Chapman, Prince Rupert Museum; (Centre) Raven and Sun Totem Pole, by Charles Edenshaw, N.M.C. Neg. No. 89097; (Right) Slate Pipe collected by Lieut. C. Wilkes in 1838, U.S. National Museum, Washington.

Raven's companion was Butterfly, who sometimes made himself into an Eagle, and is thus shown in Raven's beak.

Isaac Chapman belonged to the Eagle clan, who claimed descent from Dzelarhons. He was illegitimate, and it is thought his father was James Sykes of the Raven clan and his mother Ihlkyigang of the Eagle clan. The Eagle and Raven were the principal Haida clans on the Queen Charlotte Islands, the Ravens living at Skidegate and along the south coast of Graham Island, and the Eagles at Massett and along the north shore. The men of one married the women of the other, never of their own clan. When the Eagle chief at Massett, Stihlte Ot'iwans, learned that Sykes had abandoned Isaac Chapman, he advised an Eagle woman, Giskilas, to adopt the boy. Giskilas was married to Kwaiwas, a leading member of the Yagulanos family, of the Ravens. Stihlte did not tell Giskilas that an injury had permanently crippled the boy, but she treated him as best she could and tended him most affectionately. When he was old enough, he became apprenticed to Stihlte, a famous canoe-carver and totem-pole sculptor. Isaac specialized in argillite carving, partly because he was not strong enough to make dug-out canoes and partly because he liked delicate, ornamental work, which could only be made in argillite.

Argillite carving is most exacting and difficult. Soft when mined, this material becomes hard and brittle when exposed to air. So rapid a change prevents a sculptor from correcting a design after cutting into the argillite, but, on the other hand, this limitation is an asset to the master who can shape forms rapidly, while the slate is moist, and who polishes the surface till it becomes as brilliant as marble after it has dried.

Isaac Chapman used to keep his supply of argillite buried in moist earth. When he wished to make a miniature totem pole, he cut off a block with an ordinary saw and re-interred the rest. The design planned in his mind, he then shaped the forms with an ordinary chisel and paring knife, exactly as a woodcarver does. When the figures were finally carved, he smoothed their surfaces with a penknife and outlined eyes, feathers, teeth, hands, and feet with the flattened end of a nail, driven into a wooden handle. After the rock thoroughly dried, he polished the surface with shoe blacking and a soft cloth.

Chapman carved more deeply into the argillite than previous Haida carvers had done. Indeed, he carved so deeply at times that projecting limbs and beaks have broken off several of his totem poles. This characteristic of his work recalls the style of the native carvings which Lieutenant Charles Wilkes collected during his visit to the northwest Pacific Coast in 1838, half a century before Chapman's time.

Lieutenant Charles Wilkes commanded an exploring expedition for the United States Navy. The specimens of argillite carving that he collected now belong to the United States National Museum in Washington. Portraying characters of Haida mythology, they are all in an ornate style, which in some ways parallels Polynesian art. All Haida art, however, is quite distinct in character from the art of any other people, primitive or civilized. Where the Negro is primarily emotional, for instance, the Haida is highly sophisticated and stylized and, unlike the Indonesian, never portrays women except in her rôle as a mother, and even that quite rarely. Although to some extent influenced by Russian and New England styles, Haida art has always retained its distinctive and original character.

At the time Lieutenant Wilkes visited the northwest coast, the Haida were trafficking in sea-otter skins with traders from New England and other maritime powers. These sea-merchants transported the sea-otter pelts to Canton, where they sold them at a profit. This commerce naturally brought the natives in close contact with the whites and the objects the latter used, such as tableware and woven clothing. The influence of this contact is quite recognizable in Isaac Chapman's miniature totem pole, for down each side runs the godroon pattern he must often have seen on the silver teapots of the sailors from Boston.

During the half century that elapsed between the date of Lieutenant Wilkes' visit and the most creative period of Isaac Chapman's life, there were working in Massett the greatest of all Haida carvers, Walter King-ego and Charles Edenshaw (1861–1924). Both studied nature and strove for realistic effects. They used the artistic conventions as their predecessors had done but made the traditional patterns more realistic. A face at the foot of Edenshaw's Raven and Sun miniature totem pole in the National Museum Collection reveals that its sculptor possessed complete mastery over his idiom, for his design brings out the beauty and character of the face and is not merely an ornament, as the design of the slate carvings of 50 years earlier had been.

Chapman was trained by Edenshaw, but he developed a style very different from that of his teacher. The forms of his carvings are slender and elongated, breathing with life, a dreamy, poetic life very different from that of Edenshaw's carved gods. Edenshaw fell heir to a great chieftainship, travelled, and took pride in his ancestry. Chapman was crippled and consumptive; his temperament found expression in his work.

Chapman, while still in his twenties, died in 1911 as the result of an accident. His canoe had capsized in a gale, and he had floundered in the sea twenty minutes before his friends could rescue him. He never recovered. With his passing, the art of carving in argillite ceased. To-day his carvings are the only expression of the mystic communion a gifted people once felt with nature, and Edenshaw's gods, all that remains of their glory.

CANADIAN FOLK SONGS
COLLECTED AT BAIE-DES-ROCHERS (CHARLEVOIX)

By Luc Lacourcière and F. A. Savard

(Translated from the French)

The present study, based upon the actual state of musical folk-lore, appears as a sequel to our collection of popular tales gathered in and about the County of Charlevoix. (See the Annual Report of the National Museum, Bulletin No. 118, pp. 63-65.) This study will deal exclusively with folk songs, especially those which we have registered at La Baie-des-Rochers. In thus limiting our area we hope to arrive at a better understanding of the social aspect of their musical and poetical traditions. It might be well to recall here that in ten different parishes or "rangs" of Charlevoix we met singers who were equally as good and whose repertoire was just as varied, especially in Port-au-Persil, St. Irénée, Les Eboulements, St. Hilarion, Baie St. Paul, La Petite Rivière St. François, and elsewhere.

La Baie-des-Rochers is a "rang" (division) of St. Simeon's parish and is located about 10 miles from the church, on the way to Tadoussac. It is a sort of enclosed valley surrounded by mountains and forests. About twenty families form the entire population of about 110 inhabitants, who make their living by agriculture, fishing, and especially by lumbering. These have been their occupations for more than a century. With the exception of those men who work in the lumber camps, the people there do very little travelling. There is no electricity, and the first radio made its appearance only in 1947, though Coca-Cola had already been introduced. Life at Baie-des-Rochers is therefore quite primitive, and the setting is naturally most favourable to our folkloric investigations.

During the last few years we have made about ten visits there, each one lasting from five days to two weeks, in all seasons, and in 1947 even at Christmas. In that way we made the acquaintance of nearly all the inhabitants and were able to discover little by little their oral traditions. We registered there, either on records or on tape, one hundred songs; about an equal number have been taken down by hand. Moreover, we have the titles or "first words" of 160 others, making a total of 360 songs communicated by eighteen informers of all ages. This figure is, however, far from representing the total of all the songs known in the valley. We rejected about as many romances or modern songs extracted from printed sources, deeming them of little value to our study. It is an interesting phenomenon to note that with each succeeding visit our informers would recall several songs which had not come to mind previously. The best informers showed keen interest in this new form of sport, and they racked their brains to recall the ones they had sung in the more or less distant past. This was particularly so in the case of a woman about 60 years old who, with her sister, became our principal source of information. As she was rather timid and was not generally known to be a singer, we had not thought of her before. Moreover, because of a number of deaths in her family she had not sung for over 10 years. This detail is revealing, for often well-known singers have a very limited repertoire with which to entertain their

audience. Conversely, others sing only for themselves and when they are alone. These facts disprove the over-rigorous statistics that certain people are trying to establish in the realm of folkloric possibilities.

With regard to the repertoire of these few families we can state that it is extremely varied. A "complaint" several centuries old goes side by side in the same memory with a romance of 1900. However, the dominant types are the "chansons de métier," gay, comic, and satirical songs, drinking songs, and songs of love: in short, those which are intimately associated with everyday life and universal hopes. More rare are the sad complaints which recall tragic moments, crimes, and unusual situations. This type of song is never offered to you at first, the reason probably being that they are less suited to repetition in chorus than songs with a refrain. Their function is more intimate and their social role less apparent. Nevertheless, we must not make the mistake of thinking that the song in popular tradition serves only to entertain an audience. Its function is also to satisfy the inmost needs of lonely souls: all their feelings of joy and sorrow have already found expression in them. The mother who sings her child to sleep, the lover who hums his love in a "rossignolet," the man in the field or the woman who sings while working, care little whether or not he or she is being heard. They sing only for themselves.

Running parallel with these personal expressions are their traditional songs sung in groups: roundelays, "rondes d'enfants," dancing songs, songs recurring at different intervals or songs of circumstance, such as wedding and holiday songs. We found, however, very few ritual songs of a magical type. This last group is represented, nevertheless, by a kind of incantation intended to induce the marionettes or the "Northern Lights" to dance.

All these songs, with the exception of those that do not belong exclusively to oral tradition (romances, songs published, modern ditties released over the air), have the main characteristics of any folklorical phenomenon. They are traditional in their transmission, collective, anonymous, and their form is subject to change at least in their actual state. Their traditional characteristic is beyond question. Even the uninitiated recognize this fact immediately. These texts have, however, a certain flexibility. Their different interpretations offer an infinite variety. This phenomenon proves beyond doubt that songs with hereditary themes and melodies have been intimately associated with the individual and social life.

We have said before that these songs are collective and anonymous, but it is important to clarify the meaning and the extension of these terms.

A so-called collective song is not necessarily known and sung by everybody; it has probably never been so. It is sufficient that it be known either in the past or at the present time to several individuals. In the state of tradition, as it is at the present time, a song formerly well known may be familiar to-day to only a few persons, nay, even to an individual. This is exactly the case with regard to a thirteenth century complaint "Les Ecoliers de Pontoise" which we found at La Baie-des-Rochers. This example, among others, was brought to our attention, because we had studied the already known versions of Gaston Paris and George Doncieux (cf. Archives of Folklore, vol. 1, 1946, p. 176). In the case we have just mentioned, our informer from La Baie-des-Rochers was the only one in

her circle who knew this "complaint," which had not been sung for many years. To put it together again required a great strain on her memory, and it was only after hours of reflection that she succeeded in "piecing together" a better and a more complete version than had been heretofore collected. We were careful, naturally, not to show our singer any of these published versions.

Even in this extreme case of survival, noted at the very moment it was about to sink into oblivion, it is still a question of a collective song, for at the time it probably required twenty-five or thirty informers to bring it from its starting place in France in the Middle Ages to its arrival in Charlevoix in the twentieth century.

It is easy to conceive, how, after so many stages, this song, which had never been written down, became anonymous, i.e., without an author. In other cases, for instance, in the relatively recent songs, local complaints, or political refrains, it has been possible to retain the author's name. The anonymity is a result of the oral mode of transmission rather than a basic requirement. It is a pure accident in the definition of a popular song or of any feature of folk-lore. In any other field we may very well know the name of a workman who has made such and such a piece of furniture, and this piece of furniture does not, for that reason, lose its folklorical character as traditional or as an object of handicraft.

To return to the subject of the informer—he naturally colours every collective tradition with his own personality, which may last for the period he represents. Just how much he adds is difficult to measure, because we never know just how much he has received. Incidentally, the changes he may have made in the text are usually quite unconscious; however, there have been a few known examples where these changes have been deliberate.

There remains a word to be said in regard to the functional character of the popular song and consequently folk-lore. It would be misleading to assert that such a song has lost all its social element, merely because it is less apparent now than formerly. Frequency of use and extent of diffusion are certainly signs of life. But the social or cultural role of any traditional song whatsoever cannot be reduced to a simple question of statistics. We are bordering on the realm of the mysterious where arbitrary generalizations and principles are of no value.

If it is theoretically possible to collect all the variations of a song, to build up a critical text, and to locate all the possible informers, it would be rash to fix with certainty the individual, social, or political aspect of a particular song. Oral tradition, even in retrogression, still remains a living thing. Sometimes the visit of a folklorist in a rural area may restore to honour and put back into circulation a long forgotten text.

Though our investigations have principally a scientific purpose in view, namely, to make a study of oral tradition and to ascertain its present state, we cannot remain indifferent to the reconstruction of the cultural and spiritual current that runs from the past to the future. That is why we never fail to explain carefully, as an introduction, the reasons for our visits and for noting down what we find. We strive to emphasize the beauties as well as the value of by-gone traditions. We believe in this way that it will be possible to create an interest in communicating these texts to an attentive audience present at the time, before they become widely diffused by the publication of scientific collections or by vulgarization.

We are not deceiving ourselves, however. We realize that everywhere, even in the most conservative "rangs," such as that of La Baie-des-Rochers, folkloric tradition is, for one reason or another, in a state of constant and regular retrogression. It is not so much that the people like to sing less than they did formerly or that music does respond less to their psychic needs as it did in the past; it is that conditions have changed everywhere. The radio and phonograph have invaded nearly every home and are turned on at all hours. It is necessary to be silent, unfortunately, in order to hear them. Because of them the traditional system has changed. Musical folk-lore is not transmitted as it was formerly, exclusively by the mouth and the ear. The listeners no longer try to retain the songs heard without effort on the phonograph. If only the choice of these songs were fortunate! It is usually disastrous from the point of view of folk culture and traditional civilization.

It is of the greatest importance, therefore, that we restore, as soon as possible and in the greatest number possible, all the examples, even though fragmentary, of our popular traditional songs. The body of our folkloric music is one of the most abundant and the most varied in existence. To work to reconstruct it, to study it, and to make it known, as we are doing with the assistance of the National Museum, seems, from our point of view, to be an enterprise of incontestable social and cultural value.

NOTES ON THE BIRDS OF SOUTHERN YUKON TERRITORY

By W. Earl Godfrey

INTRODUCTION

In the course of 1949 summer field work on the birds and mammals of southwestern Yukon Territory, base camp was maintained at the south end of Kluane Lake, June 25 to July 15; on the Haines Road at Kathleen River, July 16 to August 5; and at Carcross, August 6 to 24. Transportation was by truck. Both birds and mammals were collected, but emphasis was placed on the former, and the present report is confined to the birds. In the field the writer was efficiently assisted by Colin L. Thacker, assistant technician on the National Museum staff; Ian V. F. Allen, student assistant; and Calvin D. Waterston, cook.

PLATE XXII

Jarvis River Valley, showing extensive willow-dwarf birch shrubbery. June 29, 1949. (Neg. No. 1-2).

Camp 1, June 25 to July 15, was at the south end of Kluane Lake, which is situated in the long, trenchlike Shakwak Valley at the east base of the great St. Elias Mountains. With this as base camp, the country west and south of Kluane Lake between Burwash Landing and Jarvis River was investigated, and a two-day reconnaissance trip was made to White and Donjek Rivers to the northwest. During trips to Whitehorse for supplies, the country between Kluane Lake and Whitehorse along the

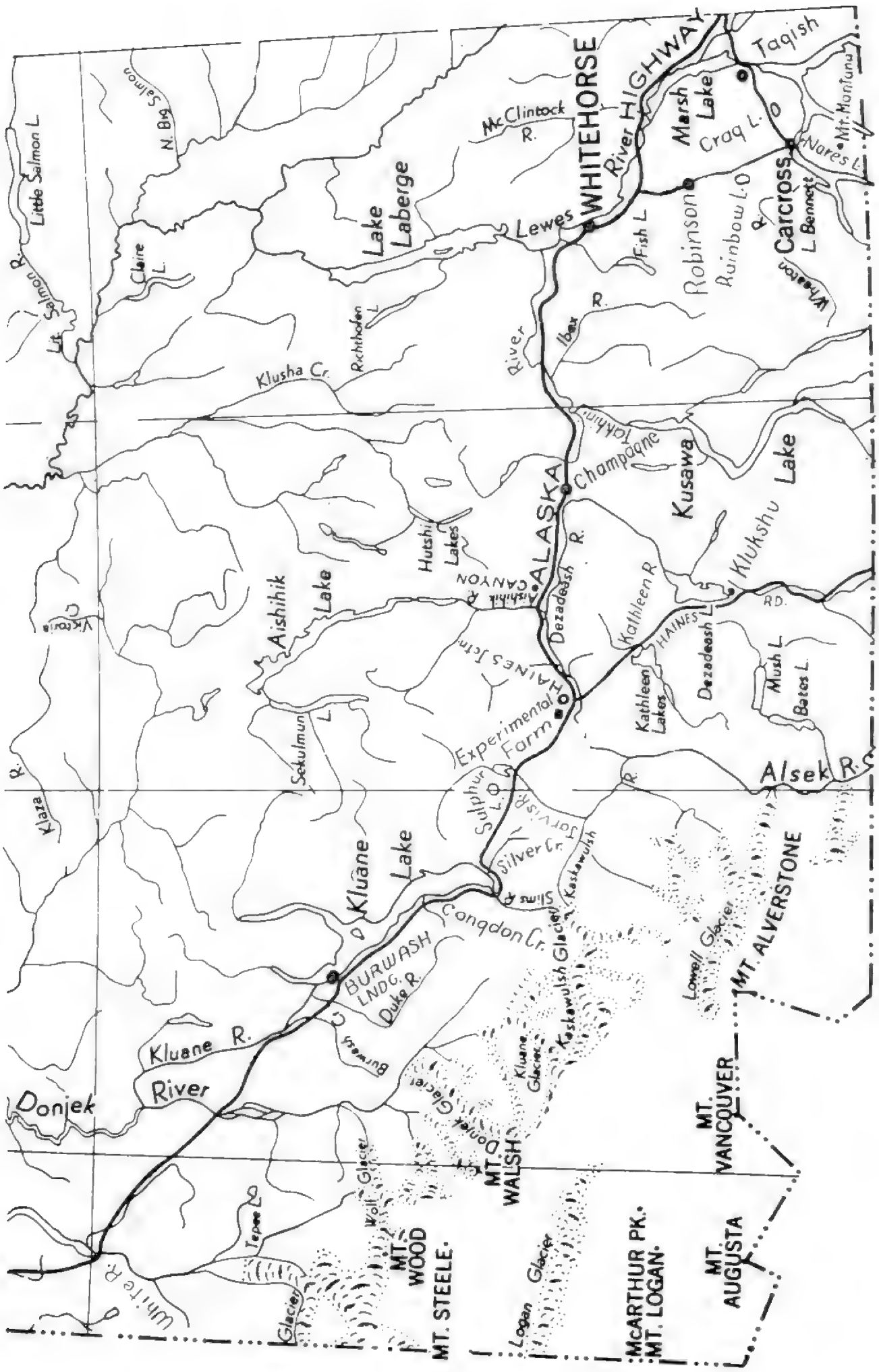

Figure 2. Map of southwestern Yukon.

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PLATE XXIII

Willow is an important cover on recent burns in the Kluane Lake region. Silver Creek. July 1, 1949. (Neg. No. 1-6).

Alaska Highway was worked as time permitted. The position of this area just east of St. Elias Mountains accounts for light precipitation in the Kluane Lake region.

Vegetation patterns are intricate with forest in the valleys and on the lower slopes of the mountains. White spruce (*Picea glauca*) is the most important forest component with balsam poplar (*Populus balsamifera*) second numerically. Black spruce is locally important in the Donjek and White Rivers areas but was not found so about Kluane Lake. Aspen, common in most parts of southern Yukon, is scarce, and lodgepole pine, which is conspicuous farther east, about Whitehorse and Carcross, is absent. In the absence of these usually subclimax trees, willow covers sparsely much of the numerous and often extensive areas recently denuded by fire, and ground birch (*Betula glandulosa*) provides some cover also. Willow, alder, and ground birch cover large areas in bogs and depressions, along streams, and the margins of lakes. Silverberry (*Eleagnus argentea*) may be locally conspicuous on some river flood plains and flats, as for example on White River, and river flats sometimes have treeless grassy areas of varying extent. Kluane Lake attracts waterfowl, and its sand beaches and mud flats are shorebird habitat. The many other small lakes and ponds often are bordered with *Equisetum* and *Carex* and are utilized by waterfowl and shorebirds.

Camp 2, July 16 to August 5, was located on the Haines Road at Kathleen River. From this base camp the country between Haines Junction and the British Columbia – Yukon border was investigated. Most of this area lies within the southern end of Shakwak Valley at the eastern base

PLATE XXIV

Excellent white spruce forest in the valley of Kathleen River. The golden-crowned kinglet, rare in Yukon Territory, was found here. August 3, 1949. (Neg. No. 5-4).

of the Kluane Range of St. Elias Mountains. Although plant distribution patterns are essentially similar to those about Kluane Lake, there are certain differences in forest composition and development. In the Kathleen River region, aspen (*Populus tremuloides*), which is of little observed importance in the Kluane region, becomes common and extensively distributed. Travelling east along the Alaska Highway from Kluane Lake, good stands of aspen are first seen a few miles west of Haines Junction. It continues to be an important subclimax element south to the British Columbia border and east in varying degrees over the rest of the area traversed by the Alaska Highway. Compared to the Kluane region, an apparently greater precipitation is reflected in the vegetation of the Haines Road country. For example, near the south end of Dezadeash Lake, mosses are luxuriant under the spruce forest, and knee-high *Equisetum* carpets the forest floor. Cow parsnip (*Heracleum lanatum*) grows head-high in forest openings. This Pacific Coast influence is apparent also in a definite racial tendency in some bird species, breeding there toward characters best developed in coastal populations.

Camp 3, August 6 to 23, was at Carcross. This region was investigated east to Tagish and north to Whitehorse, but especial attention was given to the area within a radius of 6 miles of Carcross. Carcross is situated just east of the north end of Coast Mountains. Thus the Carcross region is shielded from the humid Pacific Coast winds, and precipitation is therefore light. Forest in most places is open and in some areas, particularly about midway between Carcross and the Alaska Highway to the north,

Rainfall is light in the Carcross region, and this is reflected in sparse forest on well-drained areas. Rainbow Lake. August 21, 1949. (Neg. No. 8-5).

this dryness combines with edaphic factors to impart a decidedly prairie-like aspect. On dry ground the forest understory is usually light, and travel is easy. On sparsely wooded, dry lower slopes, buffalo berry (*Shepherdia canadensis*) is often abundant. In bogs and depressions and margins of lakes and streams, tangles of shrubbery made up mostly of willow, alder, and ericaceous plants provide cover for a variety of birds. Bennett, Nares, and Tagish Lakes and many small lakes and ponds provide abundant habitat for water birds and shorebirds. At the north end of Bennett Lake, sand dunes are both striking and extensive.

Although the country about Camp 3 shares with that at Camp 2 the abundant occurrence of aspen, it differs from both Camps 1 and 2 in that lodgepole pine (*Pinus contorta*), which is absent from the two other regions investigated, is throughout the Carcross region one of the most important forest components, often occurring in pure stands on large areas. Parenthetically, lodgepole pine was noted by the writer along the Alaska Highway west only to about 30 miles west of Whitehorse.

Rand (1946) brought together and summarized our knowledge of the distribution of birds in Yukon Territory. He included also a history of bird collecting and observation in this territory, as well as a good bibliography. Since this has been done so recently and so well, there is no point in repeating such information here.

The present paper is based mainly on the work of the National Museum's 1949 expedition to southwestern Yukon Territory. In addition, it has seemed desirable to place on record such other important unpublished

information as has come to the writer's attention. In this category are a few specimens which have been sent to the National Museum from Yukon for identification since the appearance of Rand's list.

With the kind permission of Mr. R. A. Gibson, Director, Development Services Branch, Department of Resources and Development, the more important unpublished Yukon bird distribution data contained in a manuscript report by Dr. C. H. D. Clarke are placed on record here. This report is based on Dr. Clarke's biological investigations on lands adjacent to the Alaska Highway in northern British Columbia and Yukon Territory in the summers of 1943 and 1944. The important 1943 data have already been published by Clarke (1945) and Rand (1946). The important 1944 Yukon distributional data are recorded in the present paper. In 1944 Dr. Clarke was assisted by Mr. T. M. Shortt of the Royal Ontario Museum of Zoology. They worked along the Haines Road, the Alaska Boundary section of the Alaska Highway, and in the Dawson area. The writer is grateful to both Dr. Clarke and Mr. Shortt for additional details which they furnished by correspondence.

SYSTEMATIC LIST

It will be understood that all data for which no authority is given in the list below were obtained by the 1949 National Museum field party and that the year date was 1949. In cases where information was derived from other sources, the authority for such information and full dates are given. A number in parentheses following a date is the number of bird individuals observed on that date.

Common Loon. *Gavia immer* (Brünnich)—Noted on several large and small lakes both below and above timberline.

Pacific Loon. *Gavia arctica pacifica* (Lawrence)—Uncommon summer resident. No breeding records. Three observed on July 4, apparently adults, were on a small lake 10 miles west of Donjek River bridge. They continually uttered croaks which were accompanied by much wing flapping, splashing, and head bobbing. One several times went undulating across the water surface by rising almost vertically and plunging ahead over and over again, all the while making good progress across the water. At other times it thrust itself almost out of the water by the two powerful feet—literally almost jumping out of the water. Observed also on Kluane Lake: July 5(1), 11(2).

Holboell Grebe. *Colymbus grisegena holböllii* (Reinhardt)—Observed only in the Carcross region where it was noted as follows: August 11(3 on shallow *Scirpus*-bordered lake at Mile 13, lower Carcross Road); 18 (14 at west of Crag Lake, including several well-developed but apparently still flightless young); 21(2, Rainbow Lake); 24(2, Bennett Lake). The August 18 flightless young apparently constitute the first definite breeding record for Yukon, although Rand (1946, p. 12) secured a male near Pelly River, the testes of which suggested breeding.

Horned Grebe. *Colymbus auritus* Linnaeus.—Uncommon summer resident; breeding. Two observed at Sulphur Lake, June 29; one at Two Lake Creek, Mile 1164·5, Alaska Highway on July 4; and on July 20, an adult and one young were seen at Mile 940, Alaska Highway.

Pied-billed Grebe. *Podilymbus podiceps podiceps* (Linnaeus)—T. M. Shortt observed this species on a pond near Dezadeash Lake on August 12, 1944 (Clarke, MS.). This is apparently the second Yukon record, the other being an observation on Lake Marsh, July 8, by Cantwell (1898, p. 25).

Great Blue Heron. *Ardea herodias* subsp.—Rand (1946, p. 13) placed this species on the hypothetical list of Yukon birds. On August 18, 1949, the writer saw, at about 100 yards, an immature flying over the village of Carcross. It was observed also by Allen and Waterston. A few minutes later the bird circled low over Carcross when it was observed by Gilbert Skelley of that village who said that he had never seen such a bird in his 54 years' residence in the Yukon. The bird alighted on the north end of Lake Bennett for a few minutes but disappeared shortly after and was not observed again.

Canada Goose. *Branta canadensis* subsp.—At Little Teslin Lake eighteen were observed on August 24.

Black Brant. *Branta bernicla nigricans* (Lawrence)—An unsexed specimen was forwarded to the National Museum by Mr. Fred MacLennan for identification. This was taken at Sheldon Lake in the summer of 1947 by an Indian who said that it was accompanied by another of the same kind. Neither Mr. MacLennan nor the Indian had ever seen brant before. It has not previously been recorded from southern Yukon, where it probably is accidental.

Common Mallard. *Anas platyrhynchos platyrhynchos* Linnaeus—Local breeder. Noted as follows: Kluane Lake, June 30(1); on ponds and small lakes between Donjek and White Rivers, July 4(26, including two small broods); Kathleen Lake, July 22(2), August 2(4); Carcross region, August 7(2), 9(1), 11(3), 13(14), 15(21), 19(6), 21(8); Teslin village, August 25(2).

American Pintail. *Anas acuta tzitzihoa* Vieillot—Breeds. Observed at Burwash Landing, June 24(1); Jarvis Creek, June 28(1), 29(1); on small lakes and ponds between Donjek and White Rivers, July 4(13); Takhini River, July 20(10), 22(4 ad., 4 downies); Carcross region, August 7(1), 11(9), 13(4), 19(1), 21(8); Squanga Lake, August 24(6); Teslin village, August 25(4).

Green-winged Teal. *Anas carolinensis* Gmelin—Breeds. Noted as follows: Jarvis Creek, June 28(9); Slims River mouth, July 2(1 ad., 5 downies); in small ponds between Donjek and White Rivers, July 4(9); Haines Junction, July 28(9); Carcross region, August 11(3 ad., 5 downies); Teslin Lake, August 25(1).

Baldpate. *Mareca americana* (Gmelin)—Observed at Teslin village on August 25, 1949, where seven were present.

Lesser Scaup. *Aythya affinis* (Eyton)—Rather common breeder. Teslin Lake, June 23(2); Kluane Lake region (small lakes and ponds, particularly Sulphur Lake), June 28(86), 29(72), July 9(62); along Alaska Highway between Donjek and White Rivers, July 4(5); Mile 940, Alaska

Highway, July 20(3 ad., 16 young); Carcross Region, August 7(3 ad., 14 young), 11(1 ad., 4 half-grown young), 13(30), 17(8), 18(6); Teslin village, August 25(1). Due to the impossibility of separating this species under poor observation conditions from *Aythya marila*, some of the above records might apply to the latter. However, in the many cases where field identification was possible, *affinis* was the species concerned.

Barrow Golden-eye. *Bucephala islandica* (Gmelin)—Fairly common breeder. Observed as follows: Johnson Crossing, June 23(6); Kluane Lake region, June 27(2), 28(6), 29(1), July 5(1), 9(2 ad., 5 downies); Alaska Highway near Takhini River, July 22(2 downies), August 5(1); Haines Road near Kathleen River, July 25(5 downies), 27(2 ad., 8 downies); Carcross region, August 8(2), 9(2), 11(1), 12(6), 18(7), 21(6); Watson Lake, August 25(8).

Buffle-head. *Bucephala albeola* (Linnaeus)—Fairly common breeder. Noted at Teslin Lake, June 23(1); Sulphur Lake, July 9(1 ad., 3 downies); Alaska Highway near Takhini River, July 20(1), 22(2), August 5(4); Haines Junction, July 28(1 ad., 5 downies); Kathleen River near Haines Road, July 21(1); Watson Lake, 15 miles west, August 25(2).

Old-squaw. *Clangula hyemalis* (Linnaeus)—On July 20, the writer found an adult female of this species on a small, shallow, sedge-bordered lake just west of Takhini River at the Alaska Highway. Although pintails, scaups, and a buffle-head also were on the lake, the Old-squaw displayed decided preference for the company of three Ruddy Ducks, which it followed closely. On July 22, the Old-squaw was still on the same lake and was collected. It appeared to be in good condition but, being very fat, apparently had not bred.

Specimen collected:

Takhini River (near Alaska Highway): 1 ad. ♀; July 22

Western Harlequin Duck. *Histrionicus histrionicus pacificus* Brooks —Uncommon. Observed at the south end of Kluane Lake usually resting on the rocky beach: June 27(1); July 1(6); 2(7), 14(7). All were males. Six females or immatures were noted at Crag Lake on August 9.

Specimens collected:

Kluane Lake, south end: 2 ad. ♂; June 27-July 14

Western White-winged Scoter. *Melanitta deglandi dixoni* (Brooks) —Observed only on Kluane Lake where on July 14 six were noted and on the following day twenty-eight were observed. All appeared to be males.

Surf Scoter. *Melanitta perspicillata* (Linnaeus)—Observed on both large and small lakes: Kluane Lake, July 5(4); Takhini River at Alaska Highway, July 22(2 in shallow large pond); Lake Bennett, August 10(1); Nares Lake, August 17(6).

Ruddy Duck. *Oxyura jamaicensis rubida* (Wilson)—Probably accidental. On July 20, three apparently adult males were observed by Allen and the writer on the same small lake on which the Old-squaw, recorded above, was present (near Takhini River and Alaska Highway). Under ideal conditions they were observed through an 8x binocular for almost

half an hour. Prepared to collect them, we returned to this lake on July 22 on which date they could not be found. Nor were they observed on the several later visits made by the writer to this area. The Ruddy Duck has not previously been recorded from Yukon Territory.

American Merganser. *Mergus merganser americanus* Cassin—An adult female and 11 young (almost 'flappers') at Mile 114, Haines Road, on July 27. Some of a few unidentified mergansers also may have been of this species.

Red-breasted Merganser. *Mergus serrator serrator* Linnaeus—Observed at Kluane Lake on June 27(2) and July 2(1); between Kathleen River and Dezadeash Lake, July 18(4), 27(1 ad., 6 young), 29(2); on north end of Lake Bennett a female with 3 downy young was noted on August 10, 11, and 20.

Eastern Goshawk. *Accipiter gentilis atricapillus* (Wilson)—On Silver Creek an adult on July 12; an adult at Crag Lake on August 9; an immature at Nares Lake on August 13; and another at Teslin Lake, August 25.

Eastern Sharp-shinned Hawk. *Accipiter striatus velox* (Wilson)—Uncommon. One at Burwash Landing, June 24; one at Dezadeash Lake, July 23; and at Lake Bennett one on August 8 and two on August 16.

Specimen collected:

Carcross: 1 juv. ♂; August 8

Harlan Hawk. *Buteo jamaicensis harlani* (Audubon)—Fairly common about woodland; breeds. Observed in the Kluane Lake region on July 23(1), 24(1), 27(4), 29(1), July 5(5), 8(2), 11(3), 13(1), 15(1); Kathleen River region, July 20(1), 28(2), August 4(1); Carcross region, August 9(3), 19(1), 20(1), 21(1), 22(3); Teslin, August 24(1). A great deal of variation was apparent in these hawks. Most birds had dark under parts, about half of which showed considerable white in the tail. Birds with mainly white under parts were decidedly in the minority. The specimen taken has considerable white in the tail, but no white was perceptible in the field on its mate.

Specimen collected:

Burwash Flats: 1 ad. ♂; July 5

Swainson Hawk. *Buteo swainsoni* Bonaparte—Observed in the dry country about Carcross on August 6(1) and 7(1); and near Whitehorse, August 11(1) and 21(1). Clarke (MS.) in 1944 had several records near Whitehorse and one specimen in the Dawson area, September 5.

American Golden Eagle. *Aquila chrysaëtos canadensis* (Linnaeus)—Noted in mountains in the Kluane Lake region, June 24(1), July 1(1), 2(1), 7(3); and near Carcross on August 8(2), 12(1), 24(1).

Northern Bald Eagle. *Haliaeetus leucocephalus washingtonii* (Audubon)—Observed mainly along shores of larger rivers and lakes as follows: Watson Lake, June 23(1); Kluane Lake, June 28(1); Donjek River, July 5(1); Dezadeash Lake, July 13(1), 19(1), 29(1); Kathleen Lake, July 28(1), August 2(1); near Carcross, August 12(1), 18(1).

American Marsh Hawk. *Circus cyaneus hudsonius* (Linnaeus)—This hawk was noted only once—a male quartering a broad area of burnt land east of Sulphur Lake on June 28.

Duck Hawk. *Falco peregrinus anatum* Bonaparte—On August 9 an immature specimen alighted in an alpine fir at the south end of Lake Marsh. It was much persecuted by swallows, ducking its head at each swallow stoop.

Eastern Sparrow Hawk. *Falco sparverius sparverius* Linnaeus—This is much the commonest hawk of the region on woodland and burns. Noted at Watson Lake, June 23(1); in the Kluane Lake region, June 28(3), 29(1), 30(2); July 1(1), 2(2), 5(3), 8(7), 9(5), 11(3), 12(1), 13(1), 14(1), 15(2); between Haines Junction and the British Columbia border, July 16(2), 18(3), 19(2), 20(4), 21(4), 22(1), 23(1), 27(3), 28(2), 29(4); and in the Carcross region, August 5(3), 6(3), 8(6), 9(12), 10(4), 11(9), 12(8), 13(3), 15(1), 16(5), 17(4), 18(5), 19(7), 20(6), 21(8), 22(9).

Specimens collected:

Kluane Lake (south end): 1 ad. ♂, 1 ad. ♀; June 30-July 2
Haines Road (Mile 114): 1 ad. ♂; July 27
Haines Road at Kathleen River: 1 ad. ♀; July 27
Carcross region: 4 juv. ♀; August 15-22

Richardson Grouse. *Dendragapus obscurus richardsonii* (Douglas)—Our experience supports Clarke's (MS.) assertion that this grouse does not occur in the St. Elias Range, its western limit corresponding roughly with the western limit of lodgepole pine, some 30 miles west of Whitehorse. Our only observation was of two in pine-spruce forest near Rainbow Lake on August 18.

Specimens collected:

Rainbow Lake: 1 imm. ♀, 1 imm. unsexed; August 18

Alaska Spruce Grouse. *Canachites canadensis osgoodi* Bishop—Not uncommon breeder. Noted in coniferous forest, muskegs, and once in dry, sparse aspen-willow of an old burn on a mountainside. We did not observe it in the vicinity of Kluane Lake, but on July 5 a female and at least two young were noted at Swede Johnson Creek, Mile 1119, Alaska Highway. Along Haines Road in Yukon it was much commoner, as evidenced by numerous droppings and the following observations of birds: July 18(1 ad., 3 young), 21(1), 23(1 ad, 5 young), 25(1). Within 30 miles of Carcross it was noted on August 5(1), 19(2 ad., 4 young), 20(6).

Specimens collected:

Swede Johnson Creek: 1 ad. ♀; July 5
Haines Road: 3 ad. ♀; July 18-25
Carcross region: 2 ad., 1 imm. unsexed; August 19-20

Since Rand (1948a) made his studies of this species, the collection of the National Museum has been augmented not only by the series of *osgoodi* listed above, but also by a series of eighteen *canadensis* from the Flotten Lake, Saskatchewan, region. Having examined this additional material, I agree that *osgoodi* should be recognized.

Grey Ruffed Grouse. *Bonasa umbellus umbelloides←→yukonensis*—Noted only in the Carcross region where on August 8 two adults and four young were seen, and single birds on August 12 and 13.

Specimens collected:

Carcross: 1 ad. ♀, 2 juv. ♀; August 8

This is an area of intergradation between *yukonensis* and *umbelloides*. Eleven specimens from Teslin Lake in fresh autumn plumage seem closer to *yukonensis*. The two specimens from Carcross appear to be somewhat closer to *umbelloides*, but a larger series is needed.

Keewatin Willow Ptarmigan. *Lagopus lagopus albus* (Gmelin)—Common in ground birch country above timberline; breeds.

Specimens collected:

South end of Kluane Lake: 1 ad. ♀; July 2
Mount Montana: 1 ♂; August 19

Alaskan Sharp-tailed Grouse. *Pediocetes phasianellus caurus* Friedmann—Observed on the Duke River flats where two were flushed on July 11.

Little Brown Crane. *Grus canadensis canadensis* (Linnaeus)—Clarke (MS.) observed a migration in the Dawson area, September 2-5, 1944.

Semipalmated Plover. *Charadrius hiaticula semipalmatus* Bonaparte—Singles at the mouth of Slims River on July 2, 7, and 15. Two observed there July 14.

Wilson Snipe. *Capella gallinago delicata* (Ord)—Single birds at Teslin Lake, June 23; Burwash Landing, June 27; Sulphur Lake, June 29; Alaska Highway, Mile 972, July 22.

Upland Plover. *Bartramia longicauda* (Bechstein)—Breeds. On June 30, four were noted on the grassy Slims River flats, 2 miles above the bridge. Their behaviour suggested breeding. On July 11, an adult and four well-developed young were photographed on the Duke River flats, an area where the mounds and burrows of the Yukon ground squirrel, *Citellus parryii plesius*, honeycombed the ground.

Specimens collected:

Slims River: 1 ad. ♀; June 30

Spotted Sandpiper. *Actitis macularia* (Linnaeus)—Fairly common on edges of streams and lakes throughout; breeds. Noted in the Kluane Lake region on June 25(2), 27(4), 28(2), 29(2), July 2(1), 4(5), 5(5—also nest with 4 eggs), 7(4), 9(1), 11(2), 14(3), 15(4); in the Kathleen River region on July 22(1); and in the Carcross region on August 7(10—including a young just able to fly), 8(3), 9(1), 11(2), 12(2), 13(2), 15(14), 16(7), 17(1), 18(14).

Specimens collected:

Alaska Highway (Mile 1120): 1 ad. ♂; July 5
Alaska Highway at Jarvis River: 1 ad. ♂; June 29

Eastern Solitary Sandpiper. *Tringa solitaria solitaria* Wilson—Fairly common, breeding, in muskegs and boggy country along streams,

lakes, and ponds. Observed in Kluane Lake region on June 29(1), July 4(2), 9(1), 11(1); Kathleen River region, July 13(1), 17(1), 18(1), 19(1), 20(1), 21(1), 22(5), August 4(1); Carcross region, August 12(1).

Specimens collected:

Jarvis River: 1 ad. ♂; June 29
Kathleen River: 1 ad. ♂; July 18
Dezadeash Lake: 1 ad. ♂; July 19

Only one shows tendencies toward *cinnamomea* in slight white freckling of inner edge of primary; all in dorsal coloration are undoubtedly closer to *solitaria*.

Lesser Yellow-legs. *Totanus flavipes* (Gmelin)—A common, conspicuous species about muskegs, lakes, and pond edges; breeds. Noted in the Kluane Lake region on June 27(1), 28(12), 29(13), July 4(6), 5(5), 7(1), 9(2); Kathleen River region, July 20(19), 22(4, including one well-feathered young), August 4(8), 8(1), 12(1), 21(9), 22(6).

Specimens collected:

Kluane Lake (south end): 1 ad. ♂; June 28
Alaska Highway (Mile 904): 1 imm. unsexed; August 21

Baird Sandpiper. *Erolia bairdii* (Coues)—Observed only once: a single on August 4 at Kathleen River.

Least Sandpiper. *Erolia minutilla* (Vieillot)—Observed only on July 4, at which time a single individual was seen on the west shore of Kluane Lake.

Semipalmated Sandpiper. *Ereunetes pusillus* (Linnaeus)—One in company with lesser yellow-legs on August 21 at a small pond at Mile 904, Alaska Highway.

Northern Phalarope. *Lobipes lobatus* (Linnaeus)—Observed on ponds or small lakes at south end of Kluane Lake, June 28(1); Sulphur Lake, July 9(1); Alaska Highway, Mile 986, July 20(2). The testes of the Kluane Lake male were not enlarged.

Specimen collected:

Kluane Lake (south end): 1 ad. ♂; June 28.

Long-tailed Jaeger. *Stercorarius longicaudus* Vieillot—One was observed on June 23 in a snow-storm at Burwash Landing pursuing an Arctic tern over Kluane Lake. The much restricted white on under wing and the long tail identified it as this species.

Herring Gull. *Larus argentatus smithsonianus* Coues—Fairly common about lakes and rivers, probably breeds. Observed at Haines Junction, June 25(2); Kluane Lake region, June 26(1), 27(4), 29(1), July 8(1), 9(1), 11(1); Kathleen River region, July 16(1), 19(5), 20(2), 21(7), 22(2), 23(4), 25(6), 27(2), 28(4), 29(5), August 1(6), 4(1); Carcross region, August 13(12), 17(9), 21(1).

Specimens collected:

Kathleen River: 4 ad. ♂, 4 ad. ♀; July 19-29

Measurements: 4 ad. ♂: wing, 418-434 (average 423) mm.; exposed culmen, 54·5-61·6 (57·7); 4 ad. ♀ measure: wing, 403·5-412·5 (409·0);

exposed culmen, 50·0-52·3 (51·5). These specimens show a considerable tendency toward *thayeri* in colour.

Short-billed Gull. *Larus canus brachyrhynchus* Richardson—Common about lakes and rivers; breeds. Noted in the Kluane Lake region on June 28(3), 29(1), July 2(1), 4(9), 5(6), 7(2), 9(1), 11(2), 14(6), 15(20); Kathleen River region, July 16(3), 17(2), 18(2), 21(2), 22(3), 23(4), 25(51), 27(6), August 1(2), 4(2); Carcross region, August 7(8), 9(7), 10(5), 11(3), 12(5), 13(2), 16(1), 17(2), 20(1).

Specimens collected:

Kluane Lake (south end): 1 ad. ♂; June 29
Kathleen River: 1 ad. ♀; July 20

Bonaparte Gull. *Larus philadelphia* (Ord)—Observed in the Kluane Lake region on June 28(7), 29(7), 30(2), July 4(2), where they appeared to be breeding, often darting within 10 feet of us. In the Kathleen River region the species was not noted (but it was present in the British Columbia part of the Haines Road farther south). At Nares Lake near Carcross, seventeen were seen on August 13.

Arctic Tern. *Sterna paradisaea* Pontoppidan—Observed in the Kluane Lake region on June 23(2), 25(1), 26(1), 27(4), 28(2), 29(1), 30(2), July 1(1), 2(3), 4(2), 7(1), 10(1), 12(2), 14(3), 15(3); Kathleen River region, July 23(1), 27(1), 29(1). It was much commoner south of our area in the alpine country traversed by the Haines Road in British Columbia.

Specimen collected:

Kluane Lake: 1 ad. ♂; July 14

Northwestern Horned Owl. *Bubo virginianus lagophonus* (Oberholser)—Fairly common in forests of lowlands; breeds. Noted at Kluane Lake, June 27(2); at Burwash Landing, on July 11, a nest of the Myrtle Warbler had a feather of this owl; at Kathleen River, July 16(1); at Carcross, August 7(1); at Teslin Post, August 24(1). Stomach of specimen collected contained a ground squirrel, *Citellus parryii plesius*. In its dark coloration it inclines a little toward *saturatus* but seems nearer to *lagophonus*.

Specimen collected:

Kluane Lake (south end): 1 ad. unsexed; June 27

American Hawk Owl. *Surnia ulula caparoch* (Müller)—Clarke (MS.) recorded in 1944 a brood observed by T. M. Shortt at Burwash Landing, July 5, and stated that the species was seen at Snag on August 15 and 16 and in the Dawson area early in September.

Great Gray Owl. *Strix nebulosa nebulosa* Forster—Clarke (MS.) states that one was collected by T. M. Shortt at Rousseau's Roadhouse, Flat Creek, east of Dawson on September 2, 1944.

Short-eared Owl. *Asio flammeus flammeus* (Pontoppidan)—On July 5, one was seen carrying a small rodent across a burn east of Donjek River. One was seen also at the south end of Kluane Lake on July 6.

Eastern Nighthawk. *Chordeiles minor minor* (Forster)—Noted at Burwash Landing, June 24(2); Whitehorse, June 25(1); Mile 1083, Alaska Highway, July 4(2); Kathleen River region, July 16(2), 17(1), 18(2), 20(1),

22(5), 28(1), August 3(2), 5(6); Carcross region, August 8(2), 9(2), 10(3), 11(2), 13(2), 17(2), 18(2), 19(4); Teslin Post, August 24(2). It was not seen or heard at all at the south end of Kluane Lake. It was nowhere noted in abundance.

Specimen collected:

Teslin Post: 1 juv. unsexed; August 24

Rufous Hummingbird. *Selasphorus rufus* (Gmelin)—Several people at Carcross reported having seen hummingbirds there, probably this species, in previous years. Also, at the Dominion Experimental Farm, Mile 1019, Alaska Highway, Mr. J. W. Abbott has several times seen hummingbirds in August of other years. Perhaps because of the unusually cold, wet summer of 1949, none of these observers saw hummingbirds, nor did we.

Belted Kingfisher. *Megaceryle alcyon* subsp.—Uncommon. Noted along streams and shores of lakes as follows: Donjek River, July 4(1); Experimental Farm, July 6(1); Alsek River, July 13(1); Kathleen River region, July 18(1), 23(2), 25(1), 28(1), 30(1), August 2(4), 4(3); Carcross region, August 9(1), 18(1), 19(2), 20(1); Rancheria River, August 25(1). Rand (1946) refrained from deciding the subspecific identification of southern Yukon birds. Later (1948b, p. 34), however, he referred them to the nominate race. Additional material is needed to determine this with complete certainty.

Boreal Flicker. *Colaptes auratus borealis* Ridgway—Fairly common breeder in wooded country. Noted in the Kluane Lake region, June 26(1), 27(9), 28(12), 29(12), 30(9), July 1(4), 2(6), 4(8), 5(10), 7(2), 8(2), 9(5), 11(8), 12(3), 13(2), 14(3), 15(4); Kathleen River region, July 16(3), 17(1), 18(2), 20(2), 22(8), 28(2), 29(1); Carcross region, August 9(2), 11(2), 12(2), 13(1), 16(1), 19(7), 20(5), 21(1). Young first noted out of nest June 29. Three nests observed were all in dead white spruces.

Specimens collected:

Kluane Lake (south end): 1 ad. ♂, 1 juv. ♂; July 9-11
Burwash Flats: 1 juv. ♀; July 11

Yellow-bellied Sapsucker. *Sphyrapicus varius varius* (Linnaeus)—An adult male was forwarded in the flesh in good condition to the National Museum of Canada by Mr. G. A. McIntyre of Mayo for identification. In his letter, dated May 16, 1949, Mr. McIntyre stated that the specimen was found locally and brought to him for identification. This is now preserved in the National Museum and seems to be the first Yukon specimen. However, C. B. Tidd (Rand, 1946) had a sight record of a pair in the spring of 1933 at Mayo Landing, the authenticity of which is unquestionable.

Specimen:

Mayo: 1 ad. ♂; May, 1949. G. A. McIntyre

Northern Hairy Woodpecker. *Dendrocopos villosus septentrionalis* (Nuttall)—We found this woodpecker uncommon. Outside the Carcross region, where it was seen on August 8(2), 19(1), and 20(1), we noted it but once: a single at Takhini River, July 20.

Specimens collected:

Takhini River: 1 ad. ♀; July 20
Carcross (20 miles north): 1 ♀; August 8

Downy Woodpecker. *Dendrocopos pubescens nelsoni←→glacialis*—Clarke (MS.) states that one was noted at Dezadeash Lake by T. M. Shortt on August 6, 1944, and that on August 12 one was collected there. On July 21 the writer heard the call of this species at the north end of Dezadeash Lake and later found the bird, an adult male, in spruce-aspen woodland where it was collected. These appear to be the first records for Yukon Territory.

Specimen collected:

Dezadeash Lake: 1 ad. ♂; July 21

This specimen is in size (wing, 99·1; tail, 57·0; exposed culmen, 16·3; tarsus, 17·1 mm.), lack of under tail covert spotting, and sparse, broken barring of the tail closer to *nelsoni*, but in the somewhat restricted and spot-like white markings in the wing and the slight tendency toward smoky under parts, it apparently inclines toward *glacialis*. Swarth (1926, p. 115) noted a similar but evidently less marked tendency in an Atlin, B.C. specimen.

Arctic Three-toed Woodpecker. *Picoides arcticus* (Swainson)—Clarke (MS.) and Shortt in 1944 noted this species at Dezadeash Lake and at Snag. In 1949 we observed it in white spruce forest at the south end of Kluane Lake, July 4(1) and at Sulphur Lake in tall fire-killed white spruce on July 9(2).

Specimens collected:

Kluane Lake (south end): 1 ad. ♀; July 4
Sulphur Lake: 1 ad. ♂; July 9

Alaska Three-toed Woodpecker. *Picoides tridactylus fasciatus* Baird—Fairly common; breeds. Observed at Watson Lake, June 22(2); in the Kluane Lake region on June 26(2), 30(2), July 2(1), 5(1), 9(2), 13(1), 14(1), 15(1); Kathleen River region, July 18(2), 28(1), August 4(2); in Carcross region, August 19(4), 20(2). A nest located on June 26 and another found on July 2 were in dead white spruces and contained large young.

Specimens collected:

Kluane Lake (south end): 1 ad. ♀; July 5
Kathleen River region: 2 ♂, 1 ♀; July 20-27
Carcross region: 2 ♀, 1 unsexed; August 19
Sulphur Lake: 1 ad. ♂; July 9

Eastern Kingbird. *Tyrannus tyrannus* subsp.—Clarke (MS.) states that one was clearly seen and was identified beyond question at Champagne on July 4, 1944, by both himself and T. M. Shortt. This is the first Yukon record.

Yukon Say Phoebe. *Sayornis saya yukonensis* Bishop—Local; breeds. Noted at Burwash Landing, June 23(1); about the construction camps at Mile 1056, Alaska Highway where two pairs were regularly observed between June 25 and July 16; Sulphur Lake, July 9(1); Canyon, July 20(8); Mile 1019, Alaska Highway, July 28(4); Carcross region, August 9(1), 20(2). Nest (with young) on building at Mile 1056, Alaska Highway, June 27; young flying July 9.

Specimens collected:

Kluane Lake (south end): 1 ad. ♂, 1 ad. ♀; July 11
Carcross region: 1 imm. unsexed; August 20

Alder Flycatcher. *Empidonax traillii traillii* (Audubon)—Uncommon summer resident, observed mostly in willow shrubbery. Noted at Burwash Landing, June 27(1); at Donjek River, July 4(2); 10 miles east of Donjek River, July 4(1); near Champagne, July 22(2); Alsek River, July 28(2); Carcross, August 11(2).

Specimens collected:

Champagne (5 miles east): 1 ad. ♂; July 22
Carcross: 2 juv. unsexed; August 11

The adult male measures: wing, 74·0; tail, 63·1 mm. An adult female from Sheldon Lake, Canol Road, measures: wing, 69·5; tail, 58·0. Other breeding material of this species in the National Museum is temporarily not available. I cannot therefore give an opinion on the validity of the northwestern race *alascensis*, recently proposed by Phillips (1948, p. 509). If it is valid, the Yukon birds probably are referable to it.

Least Flycatcher. *Empidonax minimus* (Baird and Baird)—This flycatcher was noted in warm aspen groves at Haines Junction, July 8(1), and a few miles farther west at the Dominion Experimental Farm also on July 8(1) and on July 13(1); and at north end of Dezadeash Lake one called several times on July 21. There is but one other previous Yukon record, a sight record at Watson Lake (Clarke, 1945), and the western Yukon records are a considerable northwestern extension of range.

Specimen collected:

Haines Junction: 1 ad. ♂; July 8

Wright Flycatcher. *Empidonax wrightii* Baird—Clarke (MS.) noted it at Dezadeash Lake, and a specimen was taken there on July 31, 1944. In 1949, we observed it only at Carcross on August 12(1), 16(1), and 18(1). Previously there was only one Yukon record, an adult specimen also at Carcross (Rand, 1946).

Specimen collected:

Carcross: 1 juv. ♂; August 16

Western Wood Pewee. *Contopus richardsonii richardsonii* (Swainson)—Not uncommon summer resident in lowland forests. Observed at Whitehorse, June 24(2); Silver Creek, July 1(1); White River, July 4(1); Mile 1083, Alaska Highway, July 5(2); Haines Junction, July 8(4); Sulphur Lake, July 9(1); Kathleen River region, July 13(2), 16(2), 17(1), 18(6), 19(3), 20(5), 21(6), 22(8), 23(2), 27(2), 28(5), 29(4), 30(2), 31(2); August 1(3), 2(4), 3(4), 4(6); Carcross region, August 13(3), 16(1).

Specimens collected:

Mile 1083, Alaska Highway: 1 ad. ♂; July 5
Kathleen River region: 1 ad. ♂, 1 ad. ♀; July 18-28
Carcross: 1 juv. ♂; August 16

These average slightly darker than specimens from the Prairie Provinces, but I cannot separate a satisfactory percentage to justify recognizing *saturatus*.

Olive-sided Flycatcher. *Nuttallornis borealis* (Swainson)—Not uncommon summer resident in lowland forests throughout area studied. Noted in the Kluane Lake region on June 26(1), 27(4), 28(4), 29(2), 30(5),

July 1(2), 2(3), 4(3), 5(4), 9(1), 12(1), 14(3), 15(1); Kathleen River region, July 16(1), 17(2), 18(3), 19(4), 20(3), 21(1), 22(2), 23(2), 28(6), 29(1); Carcross region, August 8(1), 18(2).

Specimens collected:

Kluane Lake (south end): 2 ad. ♂; June 26-July 14
Kathleen River: 1 ad. ♂; July 18

Material in the National Museum of Canada is similar to that examined by Wetmore (1939) in that it does not support the recognition of a western and eastern race of this flycatcher.

Pallid Horned Lark. *Eremophila alpestris arcticola* (Oberholser)—Fairly common on open tundra above timberline in mountains at south end of Kluane Lake and at Mile 98, Haines Road.

Specimen collected:

Kluane Lake (south end): 1 ad. ♂; July 2

Violet-green Swallow. *Tachycineta thalassina lepida* Mearns—Observed at Burwash Landing, June 24 (nesting pair); south end of Kluane Lake, June 27(3), 28(16), 29(8), 30(9), July 7(6), 8(10), 9(4), 11(7), 14(8); Dominion Experimental Farm, July 13(6), 28(6); and in the Carcross region on August 9(8). Nesting in boxes at the Experimental Farm.

Specimen collected:

Kluane Lake (south end): 1 ad. ♂; June 28

Tree Swallow. *Iridoprocne bicolor* (Vieillot)—Observed at Whitehorse, June 24(7); Canyon, July 6(1); Kluane Lake, July 11(2); Dominion Experimental Farm, July 13(1).

Bank Swallow. *Riparia riparia riparia* (Linnaeus)—Common summer resident. Noted in the Kluane Lake region, June 26(2), 27(42), 28(3), July 2(8), 11(28); Donjek River, July 4(8); Champagne, July 20(5); Kathleen River region, July 28(4), August 4(5); Carcross region, August 7(12), 8(5), 9(70), 11(3), 12(1); Lewes River, August 21(11). Nesting in gravel banks and road cuts at Burwash Landing and near Destruction Bay.

Barn Swallow. *Hirundo rustica erythrogaster* Boddaert—Observed at Johnson Crossing, June 22(2); Burwash Landing, June 24(2), 27(1); Whitehorse, June 24(6, apparently breeding in the old paddle wheeler 'Yukoner'), 11(3); Kluane Lake, south end, June 28(1); Carcross, August 7(2).

Greater Cliff Swallow. *Petrochelidon pyrrhonota hypopolia* Oberholser—Common summer resident. Nests were observed at Burwash Landing under eaves of buildings June 23 and 27; at Jarvis River under the bridge on June 29; on rocky walls above timberline at the south end of Kluane Lake on July 1; under eaves of three buildings near Haines Junction; under eaves of buildings at Carcross where on August 15 two nests still had poorly fledged young.

Specimen collected:

Jarvis River: 1 ad. ♀; June 29

This specimen is considerably paler than birds from eastern Canada.

Canada Jay. *Perisoreus canadensis pacificus* (Gmelin)—Common in coniferous forest. Noted in the Kluane Lake region, June 27(10), 28(9), 29(14), 30(20), July 1(8), 2(3), 4(12), 5(17), 7(6), 8(2), 9(17), 11(8), 12(3), 13(8), 14(6), 15(3); Kathleen River region, July 16(2), 17(2), 18(11), 19(3), 20(9), 21(7), 22(7), 23(5), 27(2), 28(11), 29(5), August 1(6), 2(5), 3(4), 4(7); Carcross region, August 9(11), 10(7), 11(5), 12(7), 13(8), 17(3), 18(10), 19(17), 20(14), 21(4), 24(7), 25(23).

Specimens collected:

Kluane Lake region: 1 ad. ♂, 1 ad. ♀, 1 juv. ♂; June 27-28
Kathleen River region: 2 ad. ♂; July 27-29
Mile 1001, Alaska Highway: 2♂, 2 ♀; July 28
Carcross region: 12 ♂, 4 ♀; August 9-22

Aldrich (1943) and Rand (1948b) have recently studied the Canada jays, arriving at very different conclusions. The series listed above contains sixteen specimens in fresh autumn plumage. Any child could separate them at a glance from an old series of three in comparable plumage from Teslin Lake taken in 1912. In the old specimens the dark slate dorsal coloration of the fresh specimens is lost entirely, being replaced by browns, and the grey of the under parts also has become very brownish. That these colour alterations take place rapidly is indicated by two Yukon specimens from Dezadeash Lake and the Canol Road, respectively, taken in 1944. In a little more than 5 years these have appreciably faded and foxed, as indicated by comparison with material collected in 1949. Obviously, interpretation of 'browner' coloration in races of this species must be made cautiously. Rand (1948b) gives additional evidence of colour changes in this species due to museum age. Although I follow Aldrich in referring Yukon material to the Alaska race, I do this on average characters and with some reservation due to their similarity also to *canadensis*. Streseman (1949) has shown that *Corvus pacificus* Gmelin is an earlier name for the race currently called *fumifrons*, and the former is therefore applied here.

American Magpie. *Pica pica hudsonia* (Sabine)—Noted near Whitehorse, June 22(1); at timberline, Kluane Mountains, July 2(1); Canyon, July 6(1 short-tailed young), 20(1), 28(1); Sulphur Lake, July 9(2); Champagne, July 22(1); Alaska Highway, Mile 1003 and 980, July 20(2 adults); Kathleen River region, August 1(1); Carcross region, August 11(3), 12(6), 13(2), 18(4), 19(4), 20(5), 21(5).

Specimens collected:

Carcross: 2 post-juv. unsexed; August 12-21

Northern Raven. *Corvus corax principalis* Ridgway—Observed usually along rivers or lakes as follows: Kluane Lake region, June 24(2), 25(1), 26(3), 27(3), July 8(1), 9(2), 11(1), 14(2), 15(4); Donjek River, July 4(5), 5(5); Johnson Crossing, August 24(1); Watson Lake, August 25(3), 26(5). It was not noted in the Carcross region.

Northwestern Crow. *Corvus caurinus* Baird—A specimen was collected by T. M. Shortt (in litt.) at Dezadeash Lake on August 4, 1944. This is the first Yukon record.

Clark Nutcracker. *Nucifraga columbiana* (Wilson)—Near Robinson on August 21 the writer observed one. Although the area was visited on several other occasions, the bird was not seen again.

Long-tailed Chickadee. *Parus atricapillus septentrionalis* Harris—Although this species was not observed in the Kluane Lake region, it was noted elsewhere in willow or willow-aspen, as follows: Between Dezadeash and Mush Lakes, July 29(4); Mile 127, Haines Road, August 1(1); Kathleen River, July 30(1), August 4(1); Carcross region, August 7(1), 10(2), 13(3), 17(4), 18(1), 19(10), 20(5); Squanga Lake, August 24(2).

Specimens collected:

Dezadeash Lake: 1 ad. ♂, 1 ad. ♀, 2 juv.; July 29
Kathleen River: 1 juv. ♂; July 30
Carcross region: 5 ad. ♂, 1 ad. ♀, 8 juv. ♂, 3 juv. ♀, 3 juv. unsexed; August 10-20

The specimens in fresh autumn plumage are very similar in coloration to a good series in comparable plumage from Flotten Lake, Saskatchewan. Compared with a single specimen of *turneri* from Alaska, the Yukon birds are less greyish and have narrower white edgings to remiges and rectrices and possess decidedly darker flanks.

Compared with four *nevadensis* from Jensen, Utah, which form Duvall (1945) says is similar in coloration to *turneri*, they are decidedly darker and have much narrower white edgings to the rectrices and remiges. Thus in colour they seem referable to *septentrionalis* as well as in size, as is indicated by measurements of seven August males: wing, 67·3-70·6 (average 66·8); tail, 65·0-70·0 (68·8) mm.

Grinnell Chickadee. *Parus gambeli grinnelli* van Rossem—A specimen taken at Dezadeash Lake on August 2, 1944, by T. M. Shortt (Clarke, MS.) is the only record for Yukon Territory.

Columbian Chickadee. *Parus hudsonicus columbianus* (Rhoads)—Very common permanent resident. Observed in coniferous forest in the Kluane Lake region on June 26(2), 27(6), 28(3), 29(5), 30(16), July 1(7), 2(5), 4(9), 5(6) 7(5), 8(7), 9(6), 11(3), 12(7), 13(7), 14(4), 15(8); Kathleen Lake region on July 17(3), 18(22), 19(8), 20(16), 21(2), 22(9), 23(2), 27(4), 28(10), 29(3), August 1(7), 4(12); Carcross region, August 9(16), 10(8), 11(11), 12(18), 13(4), 15(4), 17(14), 18(6), 19(27), 20(9), 21(5).

Specimens collected:

Kluane Lake region: 3 ad. ♂, 1 ad. ♀, 2 juv. ♂; June 27-July 15
Kathleen River region: 1 ad. ♂, 5 juv.; July 18-August 1
Carcross region: 2 ad. ♂, 7 juv.; August 15-19

Red-breasted Nuthatch. *Sitta canadensis* Linnaeus — Although Clarke (MS.) observed this nuthatch at Squanga Lake and Rancheria River in 1943, he and Shortt saw none in southwestern Yukon in 1944. Its numbers may fluctuate from year to year, as in 1949 we observed it as follows: Silver Creek, July 1(2); Slims River, July 7(1); Kathleen River region, July 16(1), 18(5), 20(1), 24(1), 27(1), 30(1), August 1(1), 2(2), 3(1), 4(11); Carcross region, August 9(2), 10(1), 12(1), 17(1), 18(1), 21(1), 24(1).

Specimens collected:

Kathleen River: 1 ad. ♀, 1 juv. ♂; July 20-August 2

Brown Creeper. *Certhia familiaris* subsp.—This species, previously unrecorded from Yukon Territory, was according to Clarke (MS.) "common at Dezadeash Lake, July 30 to August 12, 1944."

Eastern Robin. *Turdus migratorius migratorius* Linnaeus—Common summer resident, commonest in forests of lowlands, but observed several times in the ground birch zone well above timberline. Noted in the Kluane Lake region, June 27(18), 28(11), 29(9), 30(7), July 1(5), 2(8), 4(22), 5(17), 7(2), 8(12), 9(14), 11(8), 12(4), 13(7), 14(3), 15(3); Kathleen River region, July 16(2), 17(4), 18(5), 19(2), 20(7), 21(3), 22(3), 23(2), 25(8), 26(2), 28(6), 29(2), August 1(2); Carcross region, August 8(2), 9(26), 13(8), 16(1), 17(2), 18(7), 19(11).

Specimens collected:

Kluane Lake (south end): 2 ad. ♂; July 4
Kathleen River: 2 ad. ♂; July 18-August 2
Carcross region: 1 post-juv. ♂; August 18

The two Kathleen River males are very different, one being perfectly typical of the nominate race, the other perhaps tending somewhat toward *caurinus* in its darker coloration and restricted white on rectrices.

Northern Varied Thrush. *Ixoreus naevius meruloides* (Swainson)—In 1944 Clarke (MS.) and Shortt observed this species at Snag and in the Klondike area. In 1949 we found it as follows: Slims River, June 30(2), July 2(1); Donjek River, July 4(1).

Specimen collected:

Slims River: 1 ad. ♀; June 30, 1949

Eastern Hermit Thrush. *Hylocichla guttata faxoni* Bangs and Penard—Fairly common breeder in the Kluane Lake region where observed on June 27(6), 30(7), July 1(6), 2(6), 8(7), 9(1), 14(1), 15(1); Donjek River, July 4(15), 5(9); Kathleen River, July 13(2); Haines Junction, July 8(7). A nest on July 5, 10 miles east of Donjek River, was situated on the ground under a tiny spruce in open muskeg. It contained three eggs. At Haines Junction a female was noted carrying insect larvæ obviously for young on July 8.

Specimens collected:

Silver Creek: 1 ad. ♂; June 30
Donjek River (10 miles east): 1 ad. ♀; July 5

In proportions (Male: wing, 94·5; tail, 68. Female: wing, 87·5; tail, 67·2 mm.), these birds seem closer to *faxoni* than to the nominate race. They are greyer dorsally than is average for *faxoni*, but this may be due, in part at least, to their worn condition.

Alma Thrush. *Hylocichla ustulata almae* Oberholser—Common summer resident in wooded areas. Noted in the Kluane Lake region, June 27(5), 29(4), 30(6), July 1(3), 2(1), 4(6), 5(4), 8(5), 9(5), 14(5), 15(1); Kathleen River region, July 13(6), 16(3), 17(2), 18(7, including flying young), 19(3), 20(5), 23(2), 29(1), August 1(2); Carcross region, August 18(2), 19(2).

Specimens collected:

Kluane Lake region: 1 ad. ♂; July 20
Kathleen Lake region: 5 ad. ♂; 3 ad. ♀; July 13-20
Carcross region: 2 post-juv. unsexed; August 19

Although referred to *almae*, these specimens are decidedly greyer than the type specimen of *almae* and birds of the Rocky Mountains from central British Columbia south.

Gray-cheeked Thrush. *Hylocichla minima minima* (Lafresnaye)—Two observed in the willow-ground birch zone above timberline at Mile 98, Haines Road, on July 26. Although no Yukon specimens were taken, one was collected just south of the boundary in British Columbia on the preceding day. It was not observed in the Kluane Lake region.

Mountain Bluebird. *Sialia currucoides* Bechstein—Uncommon summer resident. A pair was regularly noted, June 24 to July 15 at Mile 1056, Alaska Highway, where a nest was built above a door of a construction building. On June 24 it contained young which left the nest on July 6. Noted also at Silver Creek, July 2(2); Burwash Landing, June 24(2); Stoney Creek, July 20; Carcross region, August 9(2), 10(1), 11(3), 20(6); Watson Lake, August 26(2).

Specimens collected:

Kluane Lake (south end): 1 ad. ♂, 2 juv. ♂; July 9-13
Carcross region: 2 juv. unsexed; August 20

Townsend Solitaire. *Myadestes townsendi* (Audubon)—Uncommon in the Kluane Lake region where on July 7, three were seen on the lower wooded slopes of Kluane Mountains. Noted only once on Haines Road where at Mile 123, three were seen August 1. Rather common in Carcross region where noted on August 8(7), 10(3), 11(5), 12(5), 13(2), 15(1), 17(2), 19(4), 20(4).

Specimens collected:

Kluane Lake (south end): 1 ad. ♂, 1 juv. ♂; July 7
Carcross region: 1 ad. ♀, 6 juv. ♂, 2 juv. ♀; August 8-19

Western Golden-crowned Kinglet. *Regulus satrapa olivaceus* Baird—Very rare summer resident. Clarke (MS.) states that a specimen was taken by T. M. Shortt at Hunker Summit (near Dawson) on August 30, 1944. On August 4, 1949, the writer observed three in the heavy white spruce forest along Kathleen River, of which two were collected. This species has not been recorded previously from Yukon Territory.

Specimens collected:

Kathleen River: 1 juv. ♂, 1 juv. unsexed; August 4, 1949

Eastern Ruby-crowned Kinglet. *Regulus calendula calendula* (Linnaeus)—In 1949 we found this kinglet very locally distributed in the areas visited. It was found common only in the white spruce forest along Kathleen River where it was noted on July 13(1), 16(1), 17(2), 18(8, including flying young), 19(1), 21(1), 22(2), 23(1), August 1(1), 4(4). One was noted at Takhini River, July 22.

Specimens collected:

Kathleen River: 2 ad. ♂, 5 juv.; July 18-24

In coloration these specimens tend considerably toward *grinnelli* but perhaps average closer to *calendula*. The plumage of the adults is too abraded to be useful for measurements.

Western Pipit. *Anthus spinoletta pacificus* Todd—Two were observed on the tundra above timberline in the Kluane Mountains on June 26 and six were noted on Mount Montana, above timberline, on August 19.

Specimens collected:

Mount Montana: 2 ad. ♂; August 19

Bohemian Waxwing. *Bombycilla garrula pallidiceps* Reichenow—Rather common in wooded areas. Noted in the Kluane Lake region on June 25(6), 27(20), 28(6), 30(2), July 1(1), 2(2), 7(1), 11(7), 12(1); Kathleen River region, July 16(3), 17(4), 18(4), 19(2), 20(3), 22(3), 23(1), 27(2), 29(2), August 4(3); Carcross region, August 7(2), 9(2), 10(4), 11(4), 17(5); Donjek River, July 4(5), 5(5). At Donjek River, courtship feeding was noted on July 5.

Specimens collected:

Burwash Landing: 1 ad. ♂, 1 ad. ♀; June 27
Kathleen River: 1 ad. ♂; July 22
Carcross: 1 juv. ♂, 1 juv. unsexed; August 17

Northwestern Shrike. *Lanius excubitor invictus* Grinnell—Clarke (MS.) saw this species in 1944 at Snag, August 15-20, and near Granville on September 1. In 1944 the writer noted one just below timberline near Swift River.

Tennessee Warbler. *Vermivora peregrina* (Wilson)—This warbler was noted by the writer at several points along the Alaska Highway between Watson Lake and Whitehorse on June 23. It was not seen west of Whitehorse, however. A single individual was observed near Carcross on August 18.

Eastern Orange-crowned Warbler. *Vermivora celata celata* (Say)—Two specimens of this race were taken at Carcross, one on August 13 and one on August 20. The breeding population of southwestern Yukon is, however, intermediate but closer to *orestera*. It is quite probable that some of the other migrants listed under *orestera* were actually *celata*, but this could not, of course, be determined in the field.

Specimens collected:

Carcross region: 2 juv.; August 13-20

Rocky Mountain Orange-crowned Warbler. *Vermivora celata orestera* Oberholser—Noted in poplar or willows as follows: Kluane Lake region, June 28(1), 29(3), 30(1), July 9(1), 13(5); Donjek River, July 4(2), 5(2); Haines Junction, July 8(5); Dezadeash Lake, July 29(1), Carcross region, August 12(2), 13(1), 19(6), 20(5).

Specimens collected:

Donjek River: 1 ad. ♂; July 5
Haines Junction: 1 ad. ♂; July 8
Carcross region: 3 juv.; August 12-19

The breeding adults, as well as an adult taken by Clarke at Burwash Landing on July 6, 1943, are far from typical, being decidedly intermediate between *orestera* and *celata* both in colour and size. Obviously *orestera* does not range much farther north, as the Donjek River bird is almost exactly intermediate between *orestera* and *celata*.

Northern Yellow Warbler. *Dendroica petechia amnicola* Batchelder—In the Kluane Lake region noted as follows: two adults at Jarvis River

on June 28 and 29, and one on July 8; Haines Junction, July 8(2); Dezadeash Lake, July 23(2 ad., 1 juv.), 29(2 ad. + young), August 1(1 ad. + young); Carcross, August 13(1).

Specimen collected:

Dezadeash Lake: 1 ad. ♀; July 29

It is slightly darker above than is average for *amnicola* from eastern Canada, perhaps tending toward *rubiginosa*.

Alaska Myrtle Warbler. *Dendroica coronata hooveri* McGregor—Rather common breeder in wooded parts. Noted in the Kluane Lake region, June 27(3), 28(7), 29(13), 30(11), July 1(5), 2(3), 4(10), 5(9), 7(1), 8(1), 9(2), 11(3), 12(3), 13(4), 15(2); Kathleen River region, July 16(2), 17(4), 18(7), 19(6), 20(6), 21(6), 22(5), 23(1), 28(12), August 4(31); Carcross region, August 9(6), 10(4), 11(4), 12(8), 13(5), 18(7), 19(51), 20(12), 21(6). A nest near Burwash Landing on July 11 was found 1 foot above ground in a 2-foot-high white spruce sapling. In contained six eggs.

Specimens collected:

Kluane Lake region: 2 ad. ♂, 1 ad. ♀, 1 juv. ♂; June 28-July 13
Kathleen River region: 1 ad. ♂, 1 juv. ♂, 1 juv. ♀; July 18-28
Carcross region: 2 juv. ♂, 1 juv. ♀; August 10-18

Wing measurements of the adult males are 76·5-77·0 (average 76·7) mm.

Townsend Warbler. *Dendroica townsendi* (Townsend)—Although this species was collected farther south in British Columbia at Mile 46, Haines Road, where it was not uncommon, the writer saw it but once in Yukon Territory; a male on August 17 about 10 miles east of Carcross.

Black-poll Warbler. *Dendroica striata* (Forster)—Observed in the Kluane Lake region near Burwash Landing, June 27(3), and Sulphur Lake, June 29(2) and July 9(3). At Haines Junction three were seen on July 8. In the Kathleen River valley it was noted on July 13(2), 16(1), 17(2), 18(4), 21(2), August 1(2), 3(2), 4(2). A female was seen carrying food on July 18.

Specimens collected:

Sulphur Lake: 1 ad. ♂; June 29
Kathleen River: 1 juv. ♂; July 24

Grinnell Water-thrush. *Seiurus noveboracensis notabilis* Ridgway—Very local. Seen only in the Carcross region where the writer on August 19 saw two in windfall tangles beside a small sluggish stream with many pools in spruce-balsam poplar forest some fifteen miles east of Carcross. They were not found there on the following day. On the lower slopes of Mount Montana a single specimen was collected by Allen on August 19.

Specimen collected:

Mount Montana: 1 juv. unsexed; August 19

MacGillivray Warbler. *Oporornis tolmiei tolmici* (Townsend)—Noted in three localities by the writer in 1949, as follows: On July 23 one was seen in a willow shrubbery and windfall tangle near Mile 113, Haines Road. An hour later another was noted in similar habitat about half a mile south

of there. In dense alder-willow shrubbery at the edge of timberline on a mountain side at about Mile 98, Haines Road, another was observed on July 26. This species has not previously been recorded from Yukon.

Specimen collected:

Mile 98, Haines Road: 1 ad. ♂; July 26

The writer (in press) has discussed geographic variation in this species, recognizing the nominate race and *O. t. monticola* Phillips only.

Northwestern Yellowthroat. *Geothlypis trichas yukonicola* Godfrey—This species has previously been recorded in Yukon only at Teslin Lake (Swarth, 1926), Squanga Lake (Clarke, MS.), Nisutlin and Pelly Rivers (Rand, 1946). In 1949 we found it near Swift River, June 23(3); at two points near Sulphur Lake on June 28(2); Jarvis River, June 29(1), July 8(1); near Champagne, July 22(7); Mile 118, Haines Road, July 23(1); Carcross, August 9(2), 11(3); Teslin Lake, August 25(1).

Specimens collected:

Jarvis River: 2 ad. ♂; June 29-July 8
Sulphur Lake: 1 ad. ♂; June 28
Champagne: 1 ad. ♂, 1 juv. ♀; July 22
Mile 118, Haines Road: 1 juv. ♂; July 23
Carcross region: 1 juv. ♂, 1 juv. unsexed; August 9-11

This new race was described by the writer (1950).

Northern Pileolated Warbler. *Wilsonia pusilla pileolata* (Pallas)—Fairly common summer resident. Common in ground birch and willows at or above timberline and not infrequently met with during the breeding season in willow shrubbery of lowlands. Observed in the Kluane Lake region only at Jarvis Creek, July 8(3), and near Sulphur Lake, July 9(1), and Haines Junction, July 8(1). Commoner in Kathleen River region where it was noted on July 18(2), 19(1), 21(1), 26(5), 27(1); and at Carcross where it was seen on August 10(2), 12(2), 18(1), 19(10), 20(1).

Specimens collected:

Jarvis River: 1 ad. ♂, 1 ad. ♀; July 8
Haines Junction: 1 ad. ♂; July 8
Kathleen River region: 1 ad. ♂; July 18-27
Carcross region: 2 juv. ♂, 1 juv. ♀, 2 juv. unsexed; August 10-19

Rusty Blackbird. *Euphagus carolinus* (Müller)—Observed at Burwash Landing, June 27(4); Jarvis River, June 29(1); Donjek River, July 4(5), 5(6); Kluane, July 7(1); Kathleen River region, July 13(1), August 1(8), 4(2); Takhini River, July 20(6), 22(17), Whitehorse, August 11(7); Carcross, August 19(1).

Specimens collected:

Jarvis River: 1 ad. ♀; June 29
Kathleen River region: 1 ad. ♂, 1 juv. ♂; July 13-August 2
Takhini River: 1 ad. ♀; July 20

Western Tanager. *Piranga ludoviciana* (Wilson)—A specimen collected by T. M. Shortt at Kluane on July 6, 1944 (Clarke MS.), is the only record for Yukon Territory.

Purple Finch. *Carpodacus purpureus* subsp.—On August 11, the writer heard the unmistakable call-notes of this species at the edge of Whitehorse. The bird, an immature male or a female, was soon located in

a spruce and was watched through an 8x binocular at about 35 feet for several minutes. For obvious reasons, it could not be collected. This species has not previously been recorded from Yukon.

Alaska Pine Grosbeak. *Pinicola enucleator alascensis* Ridgway—This species appears to be very scarce in summer in Yukon, judging by the experience of others. The writer observed it only on the Carcross region as follows: August 16(1), 19(2), 20(1), 22(2).

Specimens collected:

Carcross region: 1 ad. ♂, 1 sub. ad. ♂; August 19-22

I detect no tendency toward *flammula* in these specimens.

Common Redpoll. *Acanthis flammea flammea* Linnaeus—On July 23, groups of four and nine, respectively, were observed near timberline at the south end of Dezadeash Lake; and at Mile 1001, Alaska Highway, five were noted in willow shrubbery of the lowland.

Specimen collected:

Mile 1001, Alaska Highway: 1 juv. unsexed; July 28

Northern Pine Siskin. *Spinus pinus pinus* (Wilson)—The status of this species given by Rand (1946) as having been recorded in Yukon by only Bishop (1900) is amazing in view of its 1949 abundance. Presumably there are considerable year-to-year numerical fluctuations. It was noted by the writer all along the Alaska Highway both in British Columbia and Yukon, and specifically in Yukon, as follows: Kluane Lake region, June 27(1), 28(3), 29(4), 30(6), July 1(7), 2(7), 7(7), 8(5), 9(5), 11(1), 12(2), 13(3), 14(3); Donjek River, July 4(5), 5(12); Kathleen River region, July 16(6), 17(6), 18(16), 19(9), 20(8), 21(3), 22(9), 24(4), 27(1), 28(7), August 1(6), 4(12); Whitehorse, August 6(8); Carcross region, August 9(3), 10(2), 11(9), 12(7), 13(1), 17(5), 19(8), 20(9), 24(6); Teslin Lake, August 25(9); Watson Lake, August 26(2). Although Clarke (MS.) did not observe it in 1943, he and Shortt noted it in 1944 at Squanga Lake, July 2; Klukshu, July 8; and Dezadeash Lake, August 11.

Specimens collected:

Kluane Lake region: 1 ad. ♂; June 29
Kathleen River: 2 ad. ♂; August 1
Carcross region: 1 ad. ♂; August 11

Bendire Red Crossbill. *Loxia curvirostra bendirei* Ridgway—Very much rarer than the following species. A single was noted at Kathleen River on July 18; and in the Carcross region the writer noted it, also, as follows: August 11(8 in open lodgepole pine - alpine fir forest), 18(9), 20(2). In 1944 a specimen was collected by T. M. Shortt at Kluane, July 8.

Specimens collected:

Carcross region: ad. ♂, 1 imm. ♂; August 11, 1949

In the immature male the greater and middle coverts of the wing are conspicuously tipped with white, but the resulting wing bands are much narrower than in *leucoptera*. Testes of adult male measured 4 mm.

Northern White-winged Crossbill. *Loxia leucoptera leucoptera* Gmelin—Very common in all wooded areas visited; breeds; observed in the Kluane Lake region on June 26(48), 28(2), 29(47), 30(33), July 1(2), 2(65), 7(80), 8(15), 9(5), 11(3), 12(5), 13(8), 14(46), 15(14); Donjek River, July

4(14), 5(82); Kathleen River region, July 16(7), 17(38), 19(11), 20(14), 21(4), 22(7), 28(18), 29(9), August 4(6); Carcross region, August 6(6), 9(18), 10(9), 11(11), 12(6), 13(5), 16(2), 17(19), 18(47), 19(44), 20(18), 24(12); Teslin Lake, August 25(41); Watson Lake, August 26(12). On August 19, the writer watched an adult male feed a short-tailed juvenal some 10 miles east of Carcross.

Specimens collected:

Kluane Lake region: 6 ad. ♂, 3 ad. ♀; June 29-July 7
Kathleen River region: 1 ad. ♀; July 19
Carcross: 2 ad. ♂; August 17

Kodiak Savannah Sparrow. *Passerculus sandwichensis anthinus* Bonaparte—Observed at or above timberline and in grassy areas of the lowlands. Noted in the Kluane Lake region, June 26(2), 27(3), 28(4), 29(3), 30(4), July 2(1), 8(4), 9(6), 15(1); Donjek River region, July 4(11), 5(14); Kathleen River region, July 22(3), 26(2), 28(1); Carcross region, August 19(1), 21(1).

Specimens collected:

Donjek River region: 1 ad. ♀; July 5
Kluane Lake region: 3 ad. ♂, 1 ad. ♀; June 27-July 9
Carcross region: 1 juv. ♂, 1 juv. unsexed; August 19-21

One adult male from Burwash Landing, June 27, measures: Wing, 76·9; exposed culmen, 10·0; depth of bill, 5·1 mm. In dimensions it is similar, apparently, to migrant specimens described by Peters and Griscom (1938, pp. 466-467).

Slate-colored Junco. *Junco hyemalis hyemalis* (Linnaeus)—About Kluane Lake a population of junco occurs, which is perplexingly intermediate between this race and *cismontanus* but which in average characters seems closer to *hyemalis*, even though two specimens listed below very closely approach *cismontanus*. Observed both in the lowland forest and in willow-dwarf birch above timberline. Noted on June 26(8), 27(22), 28(9), 29(15), 30(17), July 1(11), 2(12), 7(12), 8(11), 9(8), 11(4), 12(5), 13(11), 14(8), 15(5). Young noted out of nest, June 27. A nest with fresh eggs, July 12.

Specimens collected:

Kluane Lake (south end): 7 ad. ♂, 5 ad. ♀, 1 juv.; June 28-July 15
Congdon Creek: 1 ad. ♀; July 2
Sulphur Lake: 1 ad. ♀; July 9

Cassiar Junco. *Junco hyemalis cismontanus* Dwight—Noted in the Kathleen River–Dezadeash Lake area on July 16(4), 17(7), 18(18), 19(10), 20(11), 21(9), 22(8), 23(5), 27(6), 28(12), 29(14), August 1(14), 4(14); and in the Carcross region on August 7(2), 8(5), 9(21), 10(19), 11(4), 12(5), 13(4), 16(3), 17(4), 18(8), 19(21), 20(9), 21(6), 24(9). The species was still singing on August 25 at Teslin Lake.

Specimens collected:

Kathleen River–Dezadeash Lake area: 4 ad. ♂, 3 ad. ♀, 3 juv.; July 18-29
Carcross region: 5 ad. ♂, 2 juv. ♂, 2 ad. ♀, 2 juv. ♀; August 9-20

Rand (1946, p. 62) comments that his specimens from the west end of Canol Road, though intermediate, are nearer *hyemalis*. However, his specimens from Nisutlin River, Rose River, and Lapie Lake (Mile 105, Canol Road) seem to the present writer closer to *cismontanus*.

Western Tree Sparrow. *Spizella arborea ochracea* Brewster—Observed in tall shrubbery both in the lowlands and above timberline. Noted at Teslin Lake, June 22(2); Kluane Lake region, June 28(14), 29(16), 30(3); July 2(12), 4(15), 8(3), 9(5); near Champagne, July 20(2), 22(1); Kathleen River region, July 21(1), 29(2); Carcross region, August 7(2), 8(2), 19(12).

Specimens collected:

Kluane Lake (south end): 6 ad. ♂, 2 ad. ♀; June 28-July 9
Mount Montana: 1 juv. ♀; August 19

Eastern Chipping Sparrow. *Spizella passerina passerina* (Bechstein)—Common summer resident of the forest and tall shrubbery of the lowlands. Noted in the Kluane Lake region on June 27(8), 28(3), 29(6), July 1(1), 2(3), 7(6), 8(12), 9(18), 11(8), 13(12), 14(9), 15(6); Donjek River, July 4(9), 5(11); Kathleen River region, July 16(2), 17(1), 18(2), 20(5), 21(3), 22(2), 28(6), 29(5), August 1(7), 4(2); Carcross region, August 7(5), 8(4), 9(12), 10(17), 11(12), 12(70), 13(18), 15(6), 16(3), 17(2), 18(21), 19(12), 20(3), 22(3). Nest, four eggs, in small white spruce at Burwash Landing, June 27.

Specimens collected:

Kluane Lake: 3 ad. ♂, 4 ad. ♀; June 28-July 11
Mile 1001, Alaska Highway: 1 ad. ♀, 1 juv. ♂; July 28
Carcross region: 1 ad. ♂, 1 ad. unsexed, 3 juv.; August 12-18

They are not typical, being larger and slightly paler than *passerina* from eastern Canada.

Timberline Sparrow. *Spizella breweri taverneri* Swarth and Brooks—Rand (1946, p. 64) placed this species on the Yukon hypothetical list on the basis of Clarke's (1945) record of one heard at Tepee Lake, July 15, 1943. Clarke (MS.) notes that T. M. Shortt definitely established its occurrence in Yukon Territory on July 8, 1944, when he located a large colony at Kluane. Mr. Shortt (in litt.) stated that six were taken.

Gambel Sparrow. *Zonotrichia leucophrys gambelii* (Nuttall)—Very common summer resident in lowland shrubbery and up to timberline. Observed in the Kluane Lake region, June 26(4), 27(24), 28(32), 29(38), 30(9), July 1(5), 2(7), 7(1), 8(9), 9(11), 11(1), 13(4), 14(3), 15(5); Donjek River area, July 4(32), 5(36); Kathleen River region, July 18(1), 19(1), 22(2), 28(4); Carcross region, August 7(1), 10(4), 12(1), 16(5), 18(2), 19(6), 20(1); Teslin Lake, August 24(1). First young out of nest were noted on July 15.

Specimens collected:

Kluane Lake region: 6 ad. ♂, 3 ad. ♀; June 28-July 9
Kathleen River: 1 juv. ♂; July 22
Carcross region: 1 ad. ♀, 3 juv.; August 12-19

Golden-crowned Sparrow. *Zonotrichia coronata* (Pallas)—In Yukon we noted it only in the mountains, above timberline, at about Mile 98, Haines Road, where two were observed on July 26. Farther south, in British Columbia, the species was common between Mile 85 and 55, Haines Road.

Alaska Fox Sparrow. *Passerella iliaca zaboria* Oberholser—Our observations fully confirm those of Clarke (MS.) that this species is absent from the Kluane area. Nor did we note it in the Kathleen River–Dezadeash Lake area nor near Carcross. We observed it only at Swift River and Teslin Lake in June. Specimens from the western part of the range currently assigned to the nominate race are darker and more greyish. This has been pointed out by Oberholser (1946) who named this race *zaboria*. The writer has examined Yukon specimens from Nisutlin, Pelly, and Macmillan Rivers, Macmillan Pass, and Sheldon Lake.

Lincoln Sparrow. *Melospiza lincolnii lincolnii* (Audubon)—Local summer resident. Observed in deciduous shrubbery of bogs and the shores of lakes and streams. Noted in the Kluane Lake region on June 27(1), 28(2), 29(2), August 8(1), 9(3); Donjek River, July 4(7), 5(7); at Mile 972, Alaska Highway, July 22(8); Carcross region, August 11(1), 19(1); Teslin Lake, August 25(2).

Specimens collected:

Jarvis River: 1 ad. ♀; June 29
Donjek River area: 1 ad. ♂, July 5
Mile 972, Alaska Highway: 2 ad. ♂; July 22
Carcross region: 1 ad. ♀; August 19

Alaska Lapland Longspur. *Calcarius lapponicus alascensis* Ridgway—A desiccated adult was found at Carcross on August 7.

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GREENLAND RIGHT WHALE RECORDED IN GASPÉ COUNTY, QUEBEC

By Austin W. Cameron

While excavating a basement at Ste. Anne des Monts, Gaspé County, Quebec, in May, 1949, Mr. François B. Paquet unearthed a fragmentary whale skull which subsequently proved to be that of a Greenland Bowhead (*Balaena mysticetus*). This discovery is of unusual biological interest, because it extends the known range of this species in the Atlantic region some 1,200 miles to the south. Although in post-glacial times the distribution of the bowhead undoubtedly included the Gulf of St. Lawrence, there is no authentic record of its having occurred south of Davis Strait within historic times (Scammon, 1874).

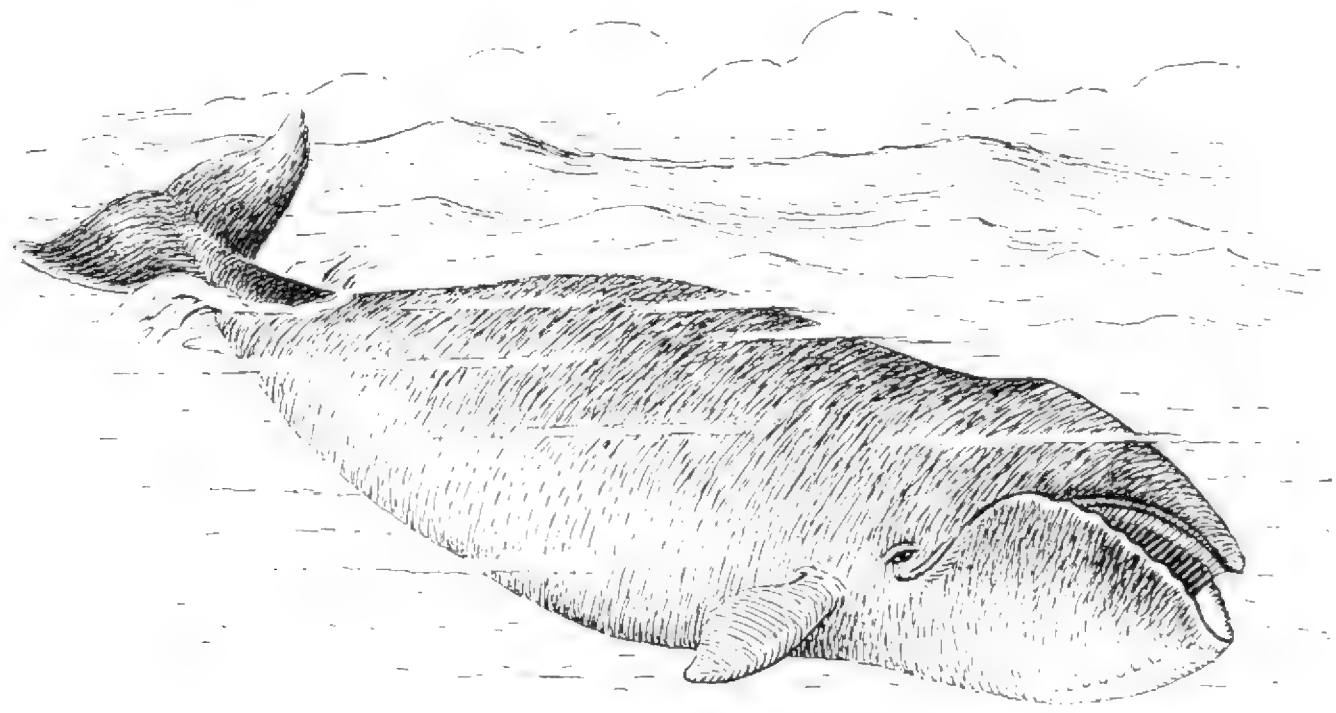

Figure 3. An adult Greenland Bowhead (*Balaena mysticetus*). The curved cleft of the mouth, unribbed throat, and finless back distinguish it as a right whale. (Drawn by C. E. Johnson, Artist, N.M.C.)

In the process of excavation, the skull was first noted at a depth of 6 feet, although it was necessary to dig an additional 5 feet before it was completely exposed. In situ the skull was some 15 feet above hightide level and approximately 150 feet from hightide mark. The surrounding soil consisted of sand and beach gravel containing a few mollusc shells. No other bones were found at the site, although whale vertebræ have been unearthed within a radius of a few miles.

Early in October, 1950, the writer examined the specimen. It was found that the entire rostrum was missing as well as the mandibles, and

many of the smaller bone structures were found to be either severely damaged or entirely lacking. It was possible, however, to obtain the following measurements:

	Cm.
(1) Greatest width of skull	268
(2) Greatest width of articular surface of zygomatic process	79
(3) Diameter of foramen magnum (transverse)	12·1
(4) Diameter of foramen magnum (ant.-post.)	14·1
(5) Length of occipital condyle	27
(6) Width of occipital condyle	18

The above measurements along with a number of photographs were forwarded to Dr. Remington Kellogg, Curator of Mammals, United States National Museum, Washington, 25, D.C., who identified the skull as that of *Balaena mysticetus* Linnaeus.

PLATE XXVI

The fragmentary skull of a Greenland Bowhead (*Balaena mysticetus*). The dome-like protuberance visible here on top of the skull is formed by the occipital condyles surrounding the foramen magnum. The flat surface below and immediately to the right is the posterior wall of the brain case.

The Greenland Bowhead or Right Whale belongs to that group of cetaceans known as the baleen or toothless whales (Mysticeti). The members of this suborder, as their vernacular names imply, are characterized by having, instead of teeth, long strips of hairlike bristles known as baleen, hanging from the roof of the mouth. The baleen whales are the largest of all mammals and are the most valuable commercially, yielding the greatest quantity of oil. In the past they were much in demand for their baleen which was used in the manufacture of ladies' bustles and collars.

The ventral surface of the basicranial region (*Balaena mysticetus*) is shown here with the lateral zygomatic processes extending to the right and left as massive bone structures.

In contrast to the streamlined Finbacks and Sulphur-bottoms, the Right Whale is stoutly built with a massive head constituting almost one third of the total body length. The velvety black adult rarely exceeds 65 feet in total length, although it yields more oil than do most species. A single animal may yield over 90 barrels, which, in addition to 1,700 pounds of baleen, is worth about $8,000 (Kellogg, 1940).

The most striking characteristics of the Right Whales, separating them from all other cetaceans, as given by Gray (1866) are: head large and massive with a highly arched upper jaw, throat not ribbed, cleft of mouth a curved line, dorsal fin lacking. Its large size and slender, flaccid baleen separates the Greenland from the North Atlantic Bowhead (*Eubalaena glacialis*).

Although the Greenland Bowhead is believed now to be restricted to the North Pacific, according to Scammon (1874) it once ranged from Spitsbergen east to Davis Strait. The North Atlantic population seems to have been exterminated between 1612 and 1887 (Kellogg, 1940). Because of the close resemblance between the two bowheads, whalers do not always make a distinction in their records; hence it is almost impossible to obtain definite information regarding the status of the Greenland form.

The writer wishes to thank all those who have assisted in the present study. Thanks are due to Dr. Remington Kellogg of the United States National Museum for examining the photographs and making the diagnosis. The kind assistance offered at Ste. Anne des Monts by Messrs. François B. Paquet, E. Gagnon, and F. Scanlan is also deeply appreciated.

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THE MAMMALS OF THE LAKE MISTASSINI AND LAKE ALBANEL REGIONS, QUEBEC

By Austin W. Cameron and William A. Morris

INTRODUCTION

A field party of the National Museum of Canada under the direction of W. Earl Godfrey conducted biological investigations in the Lake Mistassini region during the summer of 1947. Rodger O. Standfield and William A. Morris, the junior author, acted as assistants. The expedition was transported by plane from Lake St. John to Mistassini Post, where the first camp was established on June 19. Bird and mammal investigations were carried on by canoe and on foot in the vicinity of the camp. On August 3, Standfield and Morris established camp 2 on the east shore of Lake Albanel, where they remained until the termination of the field season on September 13.

During the year of 1949 the senior author made a taxonomic study of the mammal collection and prepared the present paper. In general, comments regarding ecology, distribution, and numerical status are those of the junior author. The ornithological results of the expedition were published by W. Earl Godfrey (1949).

CLIMATE AND PHYSIOGRAPHY

Lakes Mistassini and Albanel lie approximately 150 miles northwest of Lake St. John and over 200 miles east of Rupert House on James Bay. Lake Mistassini, by far the largest lake in the Province of Quebec, is about 100 miles long and averages 12 miles in breadth. Lake Albanel, lying just east of Lake Mistassini, is about 60 miles long and averages 5 miles in breadth.

Forming a link in the Hudson Bay drainage system, the lakes act as a reservoir for several rivers rising in central Ungava. The largest of these, the Temiscamie, flows into Lake Albanel, while the Tawka, Papaskwasati, and Wabissinon empty into Lake Mistassini. Into the latter lake also flows the excess water from Lake Albanel through a narrow gorge that cuts through the ridge separating the two lakes. Thus, ultimately, all of the water from this drainage basin finds its way into Lake Mistassini, from whence it drains into James Bay by way of Rupert River.

The general aspect of the topography is that of gently rolling hills with numerous muskegs and shallow ponds filling the depressions. Northwest of the region, however, the land rises to a height of over 2,000 feet above sea-level. Viewed from Lake Mistassini, this height of land appears as a series of hills on the eastern horizon.

The entire Lake Mistassini region was glaciated during Pleistocene times. The higher hills were denuded by the ice and the depressions filled with glacial drift. The numerous eskers formed by the melting ice form a characteristic series of ridges and valleys running roughly in a north-south direction. One such ridge divides the two lakes, and another flanks Lake Albanel on the east side, interrupted only near the middle where Temiscamie River enters the lake. A third partly submerged ridge extends from one end of Lake Mistassini to the other, rising at intervals above the water to form a chain of small islands (Neilson, 1947).

The bedrock is chiefly Precambrian limestone of the Grenville series, but most of this has been overlain by glacial drift. On some of the islands and along the shores of the lakes, however, the underlying limestone is exposed. Particularly along the eastern shore of Lake Albanel, limestone outcrops are conspicuous as low cliffs. The calcareous soils, resulting from limestone disintegration, may, in part at least, be responsible for the heavy forest growth in the region.

The climate is one of long, cold winters and short, cool summers. The mean temperature for January is −3·2 degrees F., and the mean temperature for July is 62·2 degrees F., as taken over a period of years by the Meteorological Division of the Department of Transport. Temperatures as low as −40 degrees F. and as high as 90 degrees F. have been recorded at Mistassini Post.

HABITATS

The forest areas of the Lake Mistassini region have been referred to the Eastern Boreal Forest Belt by Halliday (1937). The more important species are: black spruce (*Picea mariana*), white birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), balsam poplar (*Populus tacamahacca*), larch or tamarack (*Larix americana*), balsam fir (*Abies balsamea*), jack pine (*Pinus Banksiana*), and white spruce (*Picea glauca*).

Black spruce is by far the most abundant species in the region, constituting about 80 per cent of the forest in the area around Lake Mistassini. It is almost the only species that occurs in the low, poorly drained land, except for the extensive stands of larch in the bogs. Sphagnum moss and dense ericaceous shrubs form the understory throughout the black spruce forest. Poplar and birch occur in varying proportions throughout the drier parts of the spruce forest and, where suitable soil conditions prevail, white spruce and balsam fir may occur.

Numerous fires within historic time have almost completely destroyed the original spruce forest in the area east of Lake Albanel. However, scattered stands of mature spruce which escaped the fire occur at intervals throughout the burn. Poplar and birch now cover these areas, with a rank growth of *Ledum, Kalmia,* and *Vaccinium* forming the understory. Barrens created by recent fire, particularly in the Lake Albanel area, are overgrown with blueberry (*Vaccinium*).

The tops of the higher hills support stands of poplar and birch with an understory of *Ledum, Kalmia,* and *Vaccinium*. Mixed woods composed of birch, poplar, and black spruce cover the slopes, the spruce increasing as one descends into areas of poorer drainage. Jack pine with an understory of very sparse ericaceous plants and reindeer moss occupies the crests of some of the sandy ridges. In striking contrast to the other forested areas in the region where an understory of shrubbery forms an almost impenetrable jungle, the pine woods are clean and provide easy travel.

The numerous sphagnum bogs are sparsely wooded with larch and stunted black spruce. Willow, alder, Labrador tea, and laurel are other plants characteristic of the bogs. Under favorable conditions grasses and sedges often cover extensive areas.

The numerous ponds are acidic and, therefore, largely devoid of vegetation. The luxuriant growth of sphagnum which surrounds most of

them has so encroached on the water surface as to reduce many to mere pot-holes surrounded by extensive muskeg. The shrubs surrounding these ponds are almost exclusively ericaceous, forming a transition along with alder and willow between the littoral vegetation zone and the forest.

The shores of the larger lakes are generally rocky, although a number of sandy beaches do occur in the smaller bays of Lake Albanel. The rocky nature of the lake bottoms combined with excessive fluctuations in the water level greatly inhibit the growth of aquatic plants. Littoral vegetation is conspicuously absent except on a few sand beaches where shrubby cinquefoil (*Potentilla fruticosa*) and red-osier dogwood (*Cornus stolonifera*) have managed to obtain a foothold.

Man-made clearings are almost totally absent from the region except for a small field surrounding the Hudson Bay Post at Lake Mistassini. Kentucky blue grass (*Poa Pratensis*) and dandelion (*Taraxacum*) grow in this clearing.

THE MAMMAL FAUNA

Heretofore very little has been known regarding the mammal fauna of central Ungava. The first and the only annotated list appeared in an account, "Explorations in the Labrador Peninsula" by A. P. Low, published in the Annual Report of the Geological Survey of Canada for 1895. Low, who conducted several expeditions into Ungava between 1885 and 1895, was accompanied by James M. Macoun, then biologist for the Geological Survey. Presumably many of Low's data are drawn from Macoun's observations.

R. M. Anderson's "Mammals of the Province of Quebec" (1939) contains a general account of mammal distribution in the Province including the region under consideration. Subsequent to the publication of this account, he described a new race of mink (*Mustela vison lowii*) from Lake Mistassini (1945).

Neilson (1948) also made observations on the wildlife while conducting a geological survey of the Lake Mistassini region. He comments on the status of economically important species, particularly as they affect the welfare of the natives.

On the whole, in 1947 the mammal fauna was found to be rather poor both in species and numbers of individuals. Red-backed mice (*Clethrionomys*) and red squirrels (*Tamiasciurus*), which favour dense evergreen forests, appeared to outnumber, numerically, all other small mammals in the region. Species requiring more diverse habitat, such as white-footed mice (*Peromyscus*), jumping mice (*Zapus*), and chipmunks (*Tamias*) were far less common. Only where the forest was broken along the edges of streams and lakes and on the borders of burns do suitable conditions prevail for these species. The paucity of grassy clearings is probably responsible for the apparent absence of meadow mice (*Microtus pennsylvanicus*).

Considering the abundance of watered areas in the region, muskrats (*Ondatra*) were relatively scarce. This condition is probably due largely to the scarcity of aquatic plants that fail to develop in the acidic waters of these rocky lakes. Excessive trapping is also a contributing factor.

Beaver (*Castor*) also were found to be surprisingly uncommon, despite an abundance of poplar and willow along the waterways. In this case also, excessive trapping seems to be responsible for the scarcity.

Wilderness conditions in the region favour many of the fur-bearers that have been largely exterminated over the greater part of Eastern Canada. Though by no means abundant, mink (*Mustela*), lynx (*Lynx*), and otter (*Lutra*) still occur in fair numbers. Because of the inhospitable nature of the region, the human population is small, and, as a result, wildlife has not suffered the depletion that has occurred elsewhere in Eastern Canada.

Caribou (*Rangifer*), once abundant in the region, are scarce, probably as a result of indiscriminate hunting. The moose (*Alces*), on the other hand, has increased, and it would appear that it is a recent arrival in the region, as Low did not record it in 1894. According to Wilfred Jefferys, the house rat (*Rattus rattus rattus*) has not as yet reached Mistassini Post, although he found it at many other northern posts where he had previously been stationed.

ANNOTATED LIST

In sequence, the present list follows Anderson's (1946) *Catalogue of Canadian Recent Mammals*. The scientific nomenclature and vernacular names are also drawn from this source. Colour names adopted from Ridgway's (1912) *Color Standards and Nomenclature* are capitalized. Unless otherwise stated, all specimens used in subspecific determinations were in comparable pelage and of comparable age. The senior author is greatly indebted to Dr. R. M. Anderson, Honorary Curator in Mammalogy of the National Museum of Canada, for assistance in connection with the taxonomic work involved in the present study. Mr. W. Earl Godfrey of the National Museum provided valuable ecological data and offered many helpful suggestions. Thanks are also due to Messrs. Wilfred Jefferys and Emmett MacLeod of Mistassini Post for information concerning the numerical status of fur bearers in the Lake Mistassini region during the period 1942-49.

Star-Nosed Mole. *Condylura cristata cristata* (Linnaeus)—Although this species was not observed by the 1947 field party, a specimen was obtained from a local trapper at Mistassini Post on July 26.

Measurements (in mm.):

Total length, 222·5; tail, 86; hind foot, 29

Common Cinereus Shrew. *Sorex cinereus cinereus* Kerr—Only three specimens were taken. Two were taken in brush piles, the third in a thick growth of laurel, willow, and blueberry. Bacon, meat scraps, and oatmeal were used as bait in trapping this species.

Specimens taken:

Lake Albanel: 1 ♂, 2 ♀

Measurements:

Male (in mm.)—total length, 101·5; tail, 43; hind foot, 12
Females (in mm.)—total length, 98, 93; tail, 43, 42; hind foot, 12, 12

The above agree favourably in coloration and skull characters with *S. c. cinereus* from Ontario and Quebec (20). Compared with specimens of *S. c. miscix* from Labrador, they are smaller and more brownish dorsally.

White-Lipped Water Shrew. *Sorex palustris albibarbis* (Cope)—A female specimen was taken at Mistassini Post on July 8 in a trap set in a brush pile. It measured (in mm.) total length, 159·5; tail, 73; hind foot, 18·5. The underparts are dusky, and tail a uniform brown dorsally and ventrally, agreeing in these respects with specimens of *S. p. albibarbis* from southern Quebec.

Bats. *Myotis* sp.—Bats were observed on three occasions at Mistassini Post and once at Lake Albanel. Local residents reported that the previous summer thirteen were located in an old shed which was later torn down. Low (1897) reported bats as common at Lake Mistassini.

Black Bear. *Euarctos americanus* subsp.—Local residents reported black bears as not uncommon. They are most frequently seen foraging on the blueberry barrens in the autumn. At Mistassini Post, bear skins were used extensively as robes and made into articles of clothing by the Indians. Several skulls were observed hung from trees where they were placed by the Indians as a part of their religious ritual.

Red Fox. *Vulpes fulva* sp.—This species (including the black and cross phases) was rather scarce, although it was said to be plentiful in 1945. A local trapper reported seeing seventy-five during an average trapping season. Mr. Emmett MacLeod, fur-trader at Mistassini Post, reported that foxes continued scarce through the winter of 1948-49. Low (1897) states that the melanistic phase is found in a greater percentage of animals in northern Ungava than farther south. He found this fox quite plentiful.

Arctic Fox. *Alopex lagopus* subsp.—The factor of the Hudson's Bay Post at Lake Mistassini reported that a number of pelts of this species are obtained each year from trappers at Nichikun Lake, 150 miles north of Lake Mistassini. One trapper reported seeing one or two each year along the Mistassini River, east of the Post. Low (1897) noted that this species is occasionally taken in the barren grounds, but he believed that it rarely entered the timbered regions.

Wolf. *Canis lupus* subsp.—A local trapper reported that he had never seen any indications of wolves in the area. Low (1897) states that wolves were scarce in 1894 in southern Ungava ". . . since the extermination of the caribou here." Neilson (1948) also reports a scarcity of wolves in 1947.

Pine Marten. *Martes americana* subsp.—Marten were reported as very scarce, and there are no indications of increase. As a conservation measure the provincial government has declared a closed season on this species. One trapper reported having seen indications of only ten animals during his entire trapping experience. One informant believed that the destruction of mature woods by widespread fires was largely responsible for the scarcity. Low (1897) states that marten were the most abundant fur-bearing animals of Ungava. He noted that the darkest skins are taken along the northern limits of its range.

Richardson's Weasel. *Mustela erminea richardsoni* Bonaparte—Wilfred Jefferys, factor of the Hudson's Bay Company at Mistassini Post, reported weasels scarcer in 1946-1947 than in previous years. In 1948-1949

Emmett MacLeod found them abundant and increasing at Mistassini Post and predicted continued abundance in 1949-1950.

Specimens collected:

Lake Albanel, 3 ♂, 1 ♀

Measurements:

Three sub-adult males (in mm.), total length, 293, 288, 282; tail, 81, 72, 72; hind foot, 39, 40, 39

One sub-adult female (in mm.), total length, 252; tail, 63; hind foot, 31.

Ungava Mink. *Mustela vison lowii* Anderson—Mink were relatively scarce, although local trappers reported them quite plentiful in 1944. Wilfred Jefferys of Mistassini Post has noted an appreciable increase during the period 1945-1949.

Specimens collected:

Lake Albanel, 2 ♂

Measurements:

Two males (in mm.)—total length, 496, 514; tail, 158, 173; hind foot, 61, 58

The two specimens collected are near topotypes, Lake Mistassini being the type locality. They are darker than any specimens of *Mustela vison* in the National Museum of Canada collection except one specimen from Sheldon Lake, Yukon, referred to *M. v. energumenos.* The colour may be described as intermediate between Van Dyke Brown and Light Seal Brown (Ridgway). *M. v. lowii,* evidentally, is a very well defined race.

Ungava Land Otter. *Lutra canadensis chimo* Anderson—Jefferys and MacLeod reported that this species is not uncommon in the region and that it exhibits no appreciable fluctuations in population numbers as shown by fur returns. Low (1897) found it plentiful in central Ungava in 1894.

Skunk. *Mephitis mephitis* subsp.—Wilfred Jefferys, factor of the Hudson Bay Company at Mistassini Post, reported that only about twenty are brought to the Post each year. None was observed by the 1947 field party, however.

Canada Lynx. *Lynx canadensis* subsp.—Local trappers reported that this species is increasing in the region. One trapper caught ten during the 1946-1947 trapping season. Low (1897) states lynx were common in central Ungava in 1893.

[Seal. *Phoca* sp.—Neilson (1948) states that animals, believed to have been seals, have been reported from Lake Mistassini and that characteristic furrows have been seen in the snow bordering open water. The known range of the Ungava Freshwater Seal, *Phoca vitulina mellonae* Doutt, is restricted to Upper and Lower Seal Lakes, which lie approximately 350 miles north of Lake Mistassini.]

American Varying Hare. *Lepus americanus americanus* Erxleben—Rather uncommon in the region, although the presence of many trails suggested former abundance. Specimens were taken in varied habitats: alder-tamarack swamp; subclimax birch-poplar association; and dry upland mixed woods. Two were taken in traps: one set for flying squirrels and baited with apple, the other set for mink, 6 feet from a lakeshore.

James Neilson, geologist, found snowshoe hares more plentiful during the summer of 1949 in the region around Kallio Lake. Messrs. Wilfred Jefferys and Emmett MacLeod of Mistassini Post also reported (in litt.) a slight increase in 1949 around Lake Mistassini.

Low (1897) states that this species ranges throughout the wooded regions of Ungava.

Specimens collected:

Mistassini Post, 1 ♂, 2 ♀; Lake Albanel, 2 ♀

Measurements:

Adult male (in mm.)—total length, 441; tail, 22; hind foot, 136.
Adult females (in mm.)—total length, 462, 476; tail, 38, 38; hind foot, 135, 138.

Compared with four specimens of *L. a. virginianus* from Ontario and Quebec and six of *L. a. struthopus* from the Maritimes and Gaspé, the above adults are more greyish and average smaller.

Woodchuck. *Marmota monax* subsp.—This species was not observed in 1947, although several apparently deserted burrows were observed by W. Earl Godfrey in sandy ridges covered with jack pine. A melanistic female collected late in July, 1949, on the Temiscamie River, 15 miles from Lake Albanel, was obtained from Mr. James Neilson. Low (1897) states that woodchucks were common in 1894 between Lake St. John and Eastmain River.

Quebec Chipmunk. *Tamias striatus quebecensis* Cameron—Rather uncommon in the region. Mr. Emmett MacLeod, fur trader at Mistassini Post, reported having observed this species only twice during a twenty-year period. Only three were observed by the 1947 field party in addition to the two specimens collected.

Specimens collected:

Mistassini Post, 1 ♀; Lake Albanel, 1 ♀

Measurements (in mm.) of 2 ♀:

Total length, 223, ?; tail, 81, 74; hind foot, 32, 33

The above agree favourably with nine paratypes of *T. s. quebecensis* from Lake St. John.

Ungava Red Squirrel. *Tamiasciurus hudsonicus ungavensis* Anderson—This species was fairly common throughout the area, particularly on the drier birch ridges around Lake Mistassini. Local trappers reported that no cyclic fluctuations in numbers are apparent.

Specimens were taken in rat traps baited with oatmeal; one was captured in a mink trap baited with a mouse.

Specimens collected:

Mistassini Post, 3 ♂, 4 ♀; Lake Albanel, 2 ♂, 1 ♀

Measurements:

Five males (in mm.)—total length, 293·7 (277-301); tail, 108·2 (101-112); hind foot, 45 (43-48).
Five females (in mm.)—total length, 290 (279-296); tail, 110·7 (107-114); hind foot, 45·7 (44-47)

The above agree in coloration, skull characters, and measurements with topotypical material of *ungavensis* (8) in the National Museum of Canada collection. Compared with *laurentianus*, the Lake Mistassini

specimens are slightly more yellowish-rufous dorsally, and the tail is a darker red above. The tail edging is Pale Ochraceous-buff rather than Ochraceous-buff as in *laurentianus*. In striking contrast to the pale yellowish-rufous dorsal coloration of the tail in *hudsonicus*, that of *ungavensis* is a dull rust-red, approaching the colour found in *gymnicus*.

Additional material will be required from central Ungava before the respective ranges of *laurentianus* and *ungavensis* can be satisfactorily defined.

Flying Squirrel. *Glaucomys sabrinus* subsp.—None was collected, although one was observed by W. Earl Godfrey on July 8 at Mistassini Post. Local trappers reported that many are taken during the winter in traps set for other species. Mr. Eric Tate of Mistassini Post reported that he secured thirty-four in his traps during the winter of 1948-1949 at Kallio Lake, just east of Lake Albanel.

Canada Beaver. *Castor canadensis* subsp.—Beaver are rather scarce in the region, although they are said to be on the increase. This scarcity cannot be attributed to a lack of food, as there is an abundance of aspen and willow along the streams. It seems probable that excessive trapping has been largely responsible for this condition. A local trapper reported seeing on an average of thirty along Mistassini River during a season. In 1894, Low (1897) found beaver abundant throughout central Ungava north of Lake Mistassini. Neilson (1948) states that beaver were scarce in 1947.

Labrador White-Footed Mouse. *Peromyscus maniculatus maniculatus* (Wagner)—Aside from *Clethrionomys*, apparently the most abundant small mammal in the region. Specimens were collected in a variety of habitats: dry upland ridges, open stands of balsam fir, the crevices of rock piles, and on sandy beaches along lake shores.

Specimens collected:
Mistassini Post, 3 ♂, 1 ♀; Lake Albanel, 6 ♂, 3 ♀

Measurements:
Six adult males (in mm.)—total length, 164·8 (153-177); tail, 78·1 (69·5-85); hind foot, 19·9 (18-20).

The above specimens were compared with *P. m. gracilis* from southern Ontario (7), and *P. m. maniculatus* from Port Burwell, Quebec (5). Though probably intermediate, they more closely resemble *maniculatus*, being dark brown above, but tending toward a cinnamon, especially on the flanks as in *gracilis*. The ratio of the tail length to the total length in a fully adult male agrees with that found in typical *maniculatus*.

Cooper's Lemming Mouse. *Synaptomys cooperi cooperi* Baird—Although numerous runways were observed in a sphagnum bog, only two specimens were secured. Ambroid glue was used as bait.

Specimens collected:
Lake Mistassini, 1 ♂, 1 ♀

Measurements:
Male (in mm.)—total length, 95·5; tail, 14·5; hind foot, 16
Female (in mm.)—total length, 113, tail, 15·5; hind foot, 17

Hudsonian Red-Backed Mouse. *Clethrionomys gapperi hudsonius* Anderson—The most abundant species of small mammal in the Lake Mistassini region. Specimens were taken in a variety of habitats: dry upland

ridges, tamarack swamps, and in sphagnum along the edges of lakes and rivers. Most of the specimens were taken in brush piles, under fallen logs, or in runways in the sphagnum moss. Various types of bait were used: pieces of meat, ambroid glue, and a mixture of peanut butter, bacon, and chopped raisins.

A pregnant female collected July 5 contained six embryos. A male taken June 21 carried an engorged tick attached to the neck.

Specimens collected:

Mistassini Post, 20 ♂, 7 ♀; Lake Albanel, 8 ♂, 6 ♀

Measurements:

Twelve adult males (in mm.), total length, 141·5 (132-149); tail, 41·1 (35-46); hind foot, 19·3 (18-20)

Eight adult females (in mm.), total length, 144·5 (136-151); tail, 43·3 (38-47); hind foot, 18·6 (17·5-20·5)

Five out of the forty-one taken showed the grey colour phase. Approximately 10 per cent of the specimens taken by Bangs (1895) at Lake Edward and by P. A. Orkin (1950) at Lake St. John exhibit this phase. By contrast, the "*fusco-dorsalis*" phase predominates in *C. g. proteus* from Labrador.

The above differ from *C. g. ochraceus* and *C. g. gaspeanus* in being chestnut dorsally rather than ochraceous, and from *C. g. ungava* in that the dorsal stripe is well defined, and the ears protrude above the fur. Compared with sixteen specimens of *C. g. gapperi* from southern Ontario, the specimens from Lake Mistassini and Lake Albanel are duller and paler dorsally, sides more ochraceous, and underparts a deeper buff.

Rock Vole. *Microtus chrotorrhinus chrotorrinus* Miller—The single specimen secured was trapped on a dry, moss-covered, rocky outcrop in an alder swamp. The set was made at the mouth of a burrow in a rock crevice. Subsequent attempts to secure additional specimens produced only red-backed mice.

The male measured (in mm.), total length, 164·5; tail, 42; hind foot, 19·5.

This specimen agrees favourably with specimens of *M. c. chrotorrhinus* from Ontario (11) and Quebec (6). No specimens of *M. c. ravus* Bangs from Labrador are available for examination, but specimens from Moisie Bay have been referred to *chrotorrhinus*.

Muskrat. *Ondatra zibethica* subsp.—Rather uncommon. The rocky, acid lakes are sparsely vegetated, and conditions are generally unfavourable for this species. An official of the Hudson Bay Post at Lake Mistassini reported that most of the skins he received came from north of Lake Mistassini in the region of Lake Nichikun. About one hundred are taken annually along Mistassibi River.

Quebec Meadow Jumping Mouse. *Zapus hudsonius canadensis* (Davies)—Apparently rather uncommon. Two males were secured, one at Mistassini Post, the other at Lake Albanel, both in clearings in the woods. They measured as follows (in mm.)—total length, 243, 206; tail, 132, 129; hind foot, 30·5, 32.

The median dorsal stripe is a dusky olive-brown, and the sides are bright ochraceous, agreeing in these respects with specimens of *Z. h. canadensis* from New Brunswick and extreme southeastern Quebec. The dorsal median stripe is well defined, in contrast to the condition found in *Z. h. ladas* and *Z. h. ontarionensis.* The sides are brighter than in either *Z. h. acadicus* or *Z. h. hudsonius.*

Northern Woodland Jumping Mouse. *Napaezapus insignis abietorum* (Preble)—This species was found to be rather uncommon. Two were taken in a grassy clearing, another in an alder swamp, and the fourth in a grassy clearing at the edge of a sphagnum-tamarack swamp. Ambroid glue appeared to be attractive to this species.

Specimens collected:

Mistassini Post, 2 ♂; Lake Albanel, 2 ♂

Measurements:

Fully adult male (in mm.), total length, 249; tail, 151·5; hind foot, 31.5

The above specimens agree favourably in coloration with specimens of *N. i. abietorum* from Pancake Bay (12), in that the Ochraceous-tawny of the sides is washed with Clay Colour and the lateral line is clearly defined. Compared with *N. i. algonquinensis* and *N. i. saguenayensis,* they are duller on the sides, and the median dorsal band is darker than in the former, although slightly paler than in the latter.

Porcupine. *Erethizon dorsatum* subsp.—This species is very scarce in the region. None was observed at the south end of Lake Mistassini. A local trapper reported seeing five or six each year at Lake Albanel. Mr. Emmett MacLeod of Mistassini Post reported that porcupines are more common north of the lake. Low (1897) found porcupines very plentiful in central Ungava in 1894.

Moose. *Alces americana* subsp.—Local residents at Mistassini Post reported moose quite plentiful, and numerous tracks were observed by W. Earl Godfrey at Kallio Lake. Low (1897) states, "It is very doubtful if this species enters the southwest limits of Labrador from the headwaters of the Ottawa River, where it is found abundantly." Neilson (1948) makes the following statement, "There are large numbers of moose in the district [1947] and, according to the Indians, they have increased as the caribou decreased." During the summer of 1949, he observed three adults and a juvenile at Kallio Lake. They appeared to be more plentiful than in previous years. It thus seems apparent that the moose is a recent emigrant to the region.

Woodland Caribou. *Rangifer caribou* subsp.—Mr. Emmett MacLeod, fur-trader at Mistassini Post, reported that the main herds are concentrated in the region of the Eastmain Mountains east to the north shore of the Gulf of St. Lawrence. Officials of the Hudson Bay Company at Mistassini Post reported having seen five caribou killed in January, 1947, at the southeast end of Lake Mistassini. Only the females carried antlers at the time.

Low (1897) states that during a trip from Lake St. John to Lake Mistassini in 1894 not a single caribou track was seen, although 25 years previous they were said to be plentiful.

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BIOLOGICAL INVESTIGATIONS ON PRINCE PATRICK ISLAND

By S. D. MacDonald

In the period April 19 to October 12, 1949, a biological party, jointly sponsored and financed by the Smithsonian Institution, Washington, D.C., and the National Museum of Canada, investigated the Mould Bay area on Prince Patrick Island, Northwest Territories. The party consisted of Charles O. Handley, Jr., who represented the former Institution, and the writer, a member of the staff of the latter.

The general area investigated comprised the east coast of Mould Bay, the peninsula between Mould Bay and Crozier Channel, and some work was done also on the west side of the Bay. Headquarters for work was the weather station at Mould Bay.

The station is situated on a low hill overlooking the Bay and is about ten miles from its head. Just to the north, northeast, and northwest are gently sloping hills which are approximately 700 feet in height. These hills rise abruptly from the beach, and this escarpment continues for nearly three miles toward the head of the Bay. Similar escarpments are found south of the station and on the west shore of the Bay.

The tops of these hills and cliff faces are completely barren. The soil is very fine and resembles marl in appearance, though quite sandy or in some places completely covered by slabs of sandstone. In the areas where the marl-like soil is predominant, rocks of the same ochreish colour are found. These are thickly impregnated with fossil shells of several different types.

Vegetation in the form of mosses, lichens, creeping willows, grasses, sedges, and other plants clothe the hillsides and the valleys along the coast. Practically every valley is a river-bed. Fed by the melting snow on the slopes above, the streams swell to freshet-like violence, carrying large quantities of silt and depositing it on the Bay ice. These rivers gradually subside during the summer months, as their source disappears. Snow remains only in the deep "ravines" throughout the summer.

Small ponds and tiny lakes are very common along the river-banks. These, along with the marshy meadows and muskeg, seem very suitable for breeding waterfowl and shore birds. Unfortunately, much of this apparently suitable habitat is not available until too late in the season to be made use of. The number of breeding birds is small.

The interior of the peninsula is low and rolling. It is more barren and sandy than the east coast. Much of these low hills is covered with lichens, and here the caribou spend most of their time. The muskox prefers the more grassy areas. The coast along the Crozier Channel is low and sandy, with small ponds and quite well-vegetated areas.

The chief purpose of the expedition was to obtain ornithological and mammalogical collections. A small botanical collection was also made, and some fossils and animal parasites were collected. In order to give a more complete picture, habitat photographs were taken, and detailed wildlife notes were brought back. The bird and mammal distributional data obtained in this previously unworked and remote part of Canada

provide northwesternmost distributional corner-posts for the North American ranges of species occurring there.

During the period spent at Mould Bay the writer collected 207 birds, including a specimen of the Willow Warbler (*Acanthopneuste borealis*), and 122 mammals, of which 102 were lemmings, collected at intervals throughout the field season so that various phases of the pelage change would be represented.

Owing to unforeseen circumstances the greater part of the collection had to be stored for a time at Mould Bay and was flown out in April.

Appreciation is expressed to those services and individuals who kindly co-operated in making the expedition a success.

The following report on fossils collected by the writer on the island has been supplied by the Geological Survey of Canada. Lots 1 to 3 inclusive were determined by J. A. Jeletzky and lot number 4 by Hans Frebold.

Lot No. 1—West slope of "Bay Cliffs" east side of Mould Bay, $2\frac{1}{2}$ to 3 miles northwest of Mould Bay Station, near the top of the cliff. Loose on the surface. Shells lie on clay about 800-1,000 feet above sea-level.
Belemnoid; family, genus, and species undetermined. Possibly a representative of the family Oxyteuthidæ Stolley, 1919.
Age: Jurassic or Lower Cretaceous.

Lot No. 2—On west slope of "Crozier Hills", facing Crozier Channel. On surface of soft clay, etc. About 400 to 600 feet above sea-level:
(*a*) *Aucella* identical with or closely related to *A. subokensis* Pavlow.
Age: Most likely Lower Neocomian (? Infravalanginian) (Lowermost Cretaceous). Uppermost Jurassic age is much less probable but not excluded, as the date of the first appearance of this group of *Aucella* in Canada is not yet clear. At any rate it has not been proved to occur even in the uppermost Portlandian beds known in this country.
(*b*) Various pelecypods, which may or may not be contemporary with the above *Aucella*.
Age: Mesozoic or Tertiary.

Lot No. 3—Loose on creek bordering in badlands between "Bay Cliffs" and Gray Mountain and between Gray Mountain and Crozier Hills; 5 to 6 miles east of Mould Bay Station.
Acroteuthis ex gr. *subquadratus* (Roemer).
Age: This belemnoid group is restricted to deep Neocomian (Early Lower Cretaceous) in Europe. The same age is accepted for the beds carrying it on Prince Patrick Island.

Lot No. 4—Southeast slope, near summit of "Bay Cliff" about 1 mile northwest of Mould Bay Station, Prince Patrick Island—loose on surface.
There are four impressions of ammonites and three whorl fragments. Unfortunately the state of preservation is not good enough to permit a determination of these forms which belong to the same group. According to the type of the ribs, the forms may belong to the Family Perisphinctidæ.
The age of these ammonites is probably Jurassic, perhaps Upper Jurassic.

A BIOLOGICAL EXPLORATION OF BANKS AND VICTORIA ISLANDS[1]

By A. E. Porsild

An opportunity to carry out a much needed reconnaissance of the flora of Victoria and Banks Islands presented itself in the spring of 1949 when Dr. A. L. Washburn, Executive Director of the Arctic Institute, extended an invitation to the National Museum and the Geographical Bureau to join in a summer's field season in Banks and Victoria Islands. Dr. Washburn intended to continue his geological work in Victoria Island (*See* Washburn in *Geo. Soc. Amer., Mem. 22, 1947*) and, if time permitted, to carry out some preliminary work in Banks Island. He had already completed arrangements with Canadian Pacific Airways to charter a Norseman aircraft, which was to be piloted by the veteran northern flyer, Ernie Boffa, who had had considerable flying experience over Victoria and Banks Islands.

Dr. Washburn had originally planned to commence this season's work at Cambridge Bay in May. When quarantine followed the influenza epidemic there, he chose Holman Island Post instead, where Boffa landed him and Mrs. Washburn at the end of May. It was on the return from this flight that Boffa had a forced landing some fifty miles north of Coppermine when his aircraft became a total wreck. Fortunately, owing to expert handling, neither Boffa nor his mechanic was hurt, and both were rescued a few days later as the result of a most successful R.C.A.F. search directed by Wing Commander D. R. Miller.

Accompanied by Mr. J. L. Jenness of the Geographical Bureau, the writer left Ottawa on July 5 for The Pas, Manitoba, in an R.C.A.F. Canso piloted by F/O Cuthbertson, which was taking north a magnetic survey party headed by Ralph Hutchinson of the Dominion Observatory. At The Pas we transferred to an R.C.A.F. Dakota, which landed us at Yellowknife on July 7.

At Yellowknife we received the discouraging news that the season north of Great Slave Lake was unusually late; reports from Holman Island Post even indicated that it would not be possible for an aircraft on floats to land there until the end of the month, or fully two weeks later than anticipated.

The delay afforded a long hoped-for opportunity to visit the Scented Grass Hills—the 2,100-foot-high peninsula that separates the two westernmost arms of Great Bear Lake. In late August, 1928, at the conclusion of six months of exploration on Great Bear Lake, my brother Robert and I had made a brief visit to Etacho Point. Lack of time and a brewing storm without safe anchorage for our boat permitted only a hurried ascent. However, the botanical discoveries we had made strongly suggested that the summit of the peninsula might have escaped glaciation or at least that its upper levels might have stood above the latest advances of the ice, acting as a refuge for a number of plants not known to occur elsewhere in the area.

[1] This account in mimeographed form has already appeared in "The Arctic Circular," January, 1950.

The ice on Great Bear Lake was still unbroken, but Boffa believed he might find enough open shore water, or a suitable lake, where he could land us with our equipment. Accordingly, we left Yellowknife on July 9, stopping over at Port Radium to pick up some supplies and a light canoe. Crossing the lake, we circled the Scented Grass Hills. The hills are dotted with small lakes, a few of them large enough for a small aircraft to land on, but all were still ice-covered. Along the south shore of the peninsula was a narrow lead where Boffa managed to land us, 8 miles west of Etacho Point.

Except for one day when the ice moved out from the shore, Keith Arm remained choked with ice during the next two weeks. Jenness and I spent this time making a botanical survey of the limited area that we could reach on foot. On July 20, Boffa returned and succeeded in landing us on a lake near the summit of the peninsula. A few hours on the ground convinced me that, although there was abundant evidence of glaciation, the composition of the flora strongly supported my earlier contention that the plateau might have escaped the last advances of the ice and remained a nunatak refuge for a group of plants otherwise of Cordilleran range.

After returning to Radium, we learned that Holman Island Radio now reported open water on the lakes near the post, and on July 25 we were able to resume our journey. Arriving at Holman Island Post on the 28th we were warmly greeted by Dr. and Mrs. Washburn, and by the Hudson's Bay Company's Post manager, Bill Calder, who, with Father Buliard of the Roman Catholic Mission, and a few Eskimo families, made up the entire population. Most of the natives of the district were at their sealing camps at Minto Inlet and elsewhere. Even Father Buliard was at the time living at his sealing camp 10 miles up the coast, where he had 200 large seals temporarily buried in the sand of the beach. In this manner the seals keep tolerably well preserved.

Although the sea was still icebound, as far as we could see from the air, summer appeared to be at its height in the Holman Island area, and the landscape, which from the air had appeared rocky and barren, on closer inspection was ablaze with colour. In full bloom on the hillsides back of the Post were masses of creamy-white mountain avens, purple loco weeds, and magnificent yellow cinquefoils. On south-facing slopes we could even find miniature "rock gardens," all gay with purple gentians, daisies, and Lapland rhododendrons, yellow arnicas, and in rock crevices even three kinds of rock ferns.

With the season so far advanced, time was at a premium. Fortunately, two weeks of exceptionally fine weather followed and, together with the continuous daylight, made it possible to do a good deal of flying. Our first excursion took us to southern Banks Island. Crossing from Cape Wollaston to De Salis Bay we saw open leads far to the south. Southern Banks Island looked quite summery with scarcely any snow left on the land and most of the lakes free of ice. Flying through Masik Pass we saw open water in Beaufort Sea as far north as Cape Kellett. After a brief landing at Sachs Harbour on the west coast we continued along Thesiger Bay. To the south of this bay the coast is spectacular with perpendicular cliffs rising sheer from the sea to heights of 1,500 feet. We landed on a small lagoon to inspect the trap-sedimentary sequence which characterizes the cliffs. On the south-facing talus, below a cliff where a

colony of herring gulls and a pair of peregrine falcons nested in apparent harmony, we found a lush vegetation, in part composed of plants that had not been recorded from Banks Island.

A second flight from Holman Post took us first to the head of Minto Inlet, thence south to the head of Prince Albert Sound, and east by way of Tahoe and Washburn Lakes to Cambridge Bay. The return trip was by way of the south coast as far as Richardson Island from where we crossed to Prince Albert Sound, thence north and west back to Holman Island Post, along the strike of the probable contact between the trap-sedimentary sequence of the Holman Island area and the sedimentary rocks to the southeast.

The weather thus far had been good, but with the long overdue breaking-up of the sea ice we entered upon a period of unsettled weather with frequent fogs and overcast. During the remainder of the month, Dr. Washburn continued his study of geomorphological problems in western parts of Victoria Island, while, on August 10, Jenness and I set up an advance base on a small, unnamed lake in northeastern Banks Island, about thirty miles west of Russell Point. After landing us there, Boffa returned to Holman Island Post for a load of gasoline. Bad weather prevented his immediate return, and not until the 21st were we able to set out on a flight to the northwest and north coasts. During the preceding ten days northerly wind had prevailed, causing a low overcast over the northern part of the island. Poking his way through this overcast, with occasional landings when the visibility became too low, Boffa got us through to the west coast on the 22nd, landing on the south shore of Bernard Island which lies off the combined deltas of two large rivers. From 2,500 feet up, Beaufort Sea appeared to be clear of ice as far north as Bernard Island, from where the edge of unbroken polar ice stretched in a northwesterly direction. After a brief stop we followed the coast north, but we soon encountered dense fog again which forced us a considerable distance inland. Through the broken undercast we looked down on a plateau of sedimentary rocks cut by a complex system of broad canyons and river valleys that then carried very little water. In many of the canyon walls we saw fine exposures of well stratified sedimentary rocks, and in one place a thick, black band which might have been coal. Unfortunately the absence of large lakes prevented landings, so we were unable to examine this interesting landscape more closely. Flying along the southern edge of the overcast, Boffa at last picked up Thompson River, which he was able to follow to Castel Bay on the north coast. Castel Bay, as well as the nearby Mercy Bay, was open, as were narrow leads along the south shore of McClure Strait, while to the north the strait itself appeared unbroken.

We landed at the foot of Mercy Bay abreast of a conical hill which is a prominent landmark, approximately 500 feet in height. The lateness of the day and the threatening fog, which was slowly creeping in from the Polar Ice pack, made it inadvisable to remain here long enough to explore the foot of the bay for remains of McClure's winter quarters of 1851-2 and 1852-3 where his ship, the *Investigator*, was abandoned later to be broken up by Eskimo. On the beach I picked up bits of flotsam that undoubtedly were from the *Investigator*. The surface of the wood was bleached white, but scraping revealed one piece to be English oak and another to be mahogany; both were perfectly fresh and sound after nearly a hundred years

on the beach. Climbing the hill to the east we could not but wonder how many times McClure and his men, during the 3 years they were frozen in here, had climbed this identical hill to look toward the Polar Sea that never opened enough to release their ship. In the steep cliffs facing the bay we found beautifully preserved fossil corals in beds of Devonian rocks.

On the return flight to our base camp west of Russell Point we ventured a short distance out over the polar ice for a glimpse of the high and forbidding cliffs which, between Russell Point and Mercy Bay, where we crossed the coastline, rose sheer to heights approximately 600 feet. In deep river canyons cut to sea-level, fine exposures were subsequently examined in the canyon walls near the mouth of a small river that flows into Prince of Wales Strait, approximately 30 miles south of Russell Point. Fossils obtained there and at Mercy Bay have been identified as Devonian by Dr. Alice Wilson.

During the last few days the weather had been distinctly autumnal, but the following day the temperature dropped to 26°F. with a blizzard from the north which covered the ground with snow and put an end to further collecting of plants. So backward had the season been in northern Banks Island that only half a dozen species of plants had succeeded in maturing seeds, and most were overtaken by winter when their flowers had only just opened.

Breaking camp on the 24th we spent the next two days in the southern part of the island, where landings were made at De Salis Bay, Nelson Head, and on a small mountain lake near the summit of the 2,400-foot plateau which forms the southern part of the island south of Masik Pass. From Nelson Head west to Cape Lambton and thence north, the coast over a distance of about forty miles is formed by sheer cliffs rising from the sea to heights varying from 500 to 1,500 feet. The cliffs are formed of well-stratified sedimentary rocks and are capped by a great thickness of trap. Flying in perfect weather along this cliff we obtained some very fine photographs of this most spectacular part of Banks Island.

Back of the cliffs the plateau is everywhere covered by a thick mantle of angular rock debris weathered *in situ* which completely covers the underlying bedrock; this suggests that the plateau was not overridden by the glaciers that covered the middle part of the island. However, a small esker which forms the very summit of the plateau shows that at any rate a local ice-cap once rested here.

North of Masik Pass the centre of Banks Island is occupied by rolling hills which probably nowhere exceed an altitude of 1,000 feet. Toward the north end of the island, the north- and south-trending watershed approaches to within 8 miles of the east coast. The eastern part of these hills has undoubtedly been glaciated and submerged at least to the 500- to 600-foot level. Flying over this part of the island I was forcibly reminded of a huge tidal flat from which the sea has just recently receded. More than half of the surface is lake-covered and lacks well-defined drainage patterns. Here, as everywhere on Banks Island, the land surface bears abundant marks of frost action, either in the form of solifluction stripes or of soil polygons. The latter are such a characteristic feature in the landscape that in the course of the summer we jokingly came to refer to Banks Island as "Polygonia."

The northernmost part of the island is somewhat higher than the middle part and may reach altitudes of nearly 1,500 feet. This high land may have escaped glaciation; from the air, there appeared to be no pronounced glacial deposits such as eskers or moraines; furthermore, the rivers that empty into McClure Strait have eroded deep canyons that extend at least 50 miles inland. Neither at Mercy Bay nor at a lake where we landed near the southwestern edge of the highland, approximately 50 miles southwest of Castel Bay, did I see evidence of glaciation. Likewise, the presence on the west coast of Banks Island of high cliffs which contain fossil ice, such as is common on the unglaciated north coast of Alaska and in the Yukon, may indicate that the north coast, and possibly also the west coast, of Banks Island was never glaciated.

Owing to difficulty of access by sea, Banks and Victoria Islands have until lately been among the least known islands in the Canadian Arctic Archipelago. No professional botanist had previously visited these islands, and for floristic information we had largely depended upon the collections of plants made by officers of the early British expeditions under McClure and Collinson. It was not surprising, therefore, that in the first two hours of botanizing on Banks Island I doubled the known number of species of vascular plants. Although we made landings in ten different places on Banks Island and in eleven places on Victoria Island, in only one or two did time permit long enough stops for thorough collecting of plants. Nevertheless, at the end of the season the total number of vascular plants known to occur on Banks Island had been increased from 65 to 174, and that of Victoria Island from 106 to 201 species. Although the total number of species is low, a relatively large percentage is endemic to the Canadian Arctic Archipelago, a fact which suggests long isolation. Contrary to expectation the flora of both islands proves phytogeographically to be more closely related to the Cordillera than to the flora of Alaska and northern Yukon.

As already stated, the summer of 1949 was climatically an unusually backward one in the western Arctic; the break-up occurred almost three weeks later than normal, and not until late August did the first boat get into Cambridge Bay.

Animal life, naturally, was greatly affected by the late season, and many migratory birds that normally breed in Banks and Victoria Islands either did not reach their nesting grounds or failed to breed. Throughout the summer we saw very few small land or shore birds, and some of those we did see obviously had not bred. All summer we saw only one brood of rock ptarmigan and one flock of twenty-eight black brant. We did see a number of yellow-billed and red-throated loons, but they, too, had reared no young. In fact, the only breeding land birds that were at all common were falcons and rough-legged hawks. But even those had experienced hard times, for a pair of gyrfalcons which had nested on a cliff at Mercy Bay had raised but one young, and this, when almost full-grown, had starved to death below the nest. On August 5 the nest of a pair of peregrine falcons south of Washburn Lake contained four unhatched eggs.

Judging from the abundance of their burrows, lemmings formerly had been abundant on both Banks and Victoria Islands; last summer they were very scarce. On Banks Island we saw collared lemmings in one place

only, on a strand flat 20 miles south of Russell Point. On Victoria Island, although generally speaking very scarce, they were reported to be increasing in the vicinity of Cambridge Bay. Foxes, too, were very scarce, and only a few tracks were seen. In a letter written just before Christmas, Bill Calder reports that only ten foxes had been traded at Holman Island Post and that the outlook was very poor. Wolves and Arctic hares were seen on a number of occasions; caribou appeared to be relatively plentiful, and fresh tracks were seen everywhere; in late August scattered small herds, composed mostly of does with their fawns, were seen in the northern part of Banks Island. Although we kept a sharp look-out for musk-oxen, we did not actually see any. However, a few may still exist on the island, for we saw old tracks of a small number at Mercy Bay. When crossing Amundsen Gulf on August 25, we saw a large bowhead whale which obligingly remained surfaced while we circled low over the perfectly calm sea.

Although much too short for the work on hand, the field season of 1949 had been a profitable and most enjoyable one for all of us. This was largely due to the splendid and enthusiastic collaboration by all members of the party, not least by our pilot and his mechanic, who maintained the keenest interest in the work of all members of the party and, in the face of the multifarious demands made upon them in the interest of geology, geography, and botany, remained ever unperturbed and helpful.

BOTANICAL INVESTIGATIONS ALONG THE HAYES RIVER ROUTE, NORTHERN MANITOBA

By H. J. Scoggan

During the summer of 1949, a botanical survey was conducted by the writer along the canoe route of the Nelson-Echimamish-Hayes river system leading from Norway House, off the northeast end of Lake Winnipeg, to York Factory on Hudson Bay. The return trip was made by ascending the Nelson from its mouth to Limestone Rapids, where the party entrained at Mile 352 for Wekusko. The latter part of the season was spent in the area of Wekusko Lake and Tramping Lake. The party included two Technical Officers: Nick Neufeld of Winnipeg, Man., and John D. Campbell of Hamilton, Ont. James S. Robinson of Norway House was employed as cook.

The writer acknowledges gratefully the advice and help of Mr. J. Glass, Manager of the Manitoba Section of the Fur Trade Department, Hudson's Bay Company, and the assistance and hospitality of Mr. T. McEwan, manager of the Company's post at Norway House; Mr. J. Wood, manager of the Oxford House post; and Mr. T. Retallack, manager of the York Factory post. Towards the end of the season, Mr. Ralph Bryenton of Herb Lake village on Wekusko Lake kindly placed his home at the disposal of the party, for which grateful thanks are hereby extended.

HISTORICAL SKETCH

Alcock (1920) has given a general account of the development of trade routes in Western Canada as far west as the foothills of the Rocky Mountains and the mouth of the Mackenzie River. Because of the former great importance of the Hayes system as a fur trade and colonization route, and its rapid decline following the advent of the railway and steam navigation, the following chronological notes, including mention of the work of early plant collectors, deserve consideration in the present paper. The main sources are Innis (1930), Morton (undated), and Rich (1938).

1610—Henry Hudson, in search of the North-West Passage, wintered near the mouth of Rupert River, at the south end of James Bay.

1612—Button's expedition, continuing the quest, entered the estuary of the Nelson River to winter, taking possession of the land for England.

1631—By this date, three years before the death of Champlain, seventeen expeditions (sixteen English and one Danish) had approached the northern forest belt by sea, while in the south the French had come within easy reach of it from the St. Lawrence.

1650—Defeat of the Hurons by the Five Nations, shattering the machinery of the French fur trade.

1661—Groseilliers and Radisson penetrated the beaver country of the northern forest belt, tapping the stream of furs at its source. The subsequent rejection by the French Court of Groseilliers' plans for new ventures to Hudson Bay gave the English an entry to the great fur belt, and proved decisive for the history of the Canadian Northwest.

1668—Groseilliers (the "Mr. Gooseberry" of old Hudson's Bay Company documents), with an English expedition under the command of Captain Gillam, reached Rupert River. The building there of Fort Charles effected the first direct and vital contact of the Northwest with Europe.

1670—Incorporation of the Hudson's Bay Company.

1682—Establishment of Fort Nelson, the first Hudson's Bay Company post in Canada, in the estuary of the Nelson. Radisson ascended the Hayes to the mouth of the Fox, bringing back Indians to the ships to trade.

1684—Establishment of York Factory near the mouth of the Hayes, following the destruction of Fort Nelson by the French the preceding year. York Factory is the oldest permanent settlement in Manitoba. Until the building of the railway, goods from England for the interior were routed through this main supply centre of the Company, while furs were sent to England on the return voyages. The post is now merely a distribution point for a few small stations some hundred miles distant.

1688—Establishment of Fort Churchill near the mouth of Churchill River.

1690—Henry Kelsey travelled from York Factory up the Hayes to its confluence with the Fox, thence to Cross Lake and up Minago River. He reached Saskatchewan River the following year. Kelsey was the first European to see the Indians and buffalo of the plains.

1757—Joseph Smith was the first European to make use of the Hayes route followed by the writer's party. This route, via Oxford, Knee, and Swampy Lakes, became the great trade route into the interior for large canoes and York boats of the Hudson's Bay Company.

1774—Establishment of Cumberland House in present-day Saskatchewan by Samuel Hearne, marking the beginning of the policy of penetration into the interior by the Hudson's Bay Company, in answer to the opposition of rival fur traders. Cumberland House is the oldest permanent settlement in Saskatchewan.

1794—David Thompson surveyed a new route between Cumberland House and York Factory via Goose, Reed, and Burntwood Lakes to the Nelson.

1798—Establishment of Oxford House on Oxford Lake.

1811—Conveyance to Lord Selkirk, for the settlement of a group of Irish colonists, of an area of about 116,000 square miles in what is now Manitoba, Saskatchewan, North Dakota, and Minnesota. Miles Macdonell was chosen Governor of Assiniboia, and set out with an advance party to prepare for the arrival of the settlers the following year. Forced to winter at the mouth of the Nelson, the group travelled up the Hayes the following spring and reached the site of the present town of Pembina, N. Dak.

1812—Arrival of the main band of Red River colonists at York Factory. Travelling up the Hayes by way of Oxford House, they reached their final destination toward the end of October.

1814—Establishment of the Norway House post. Macdonell left for York Factory to survey the route with a view to the construction of a

"winter road" for easy communication with the colony. Eight Norwegians, under Peter Fidler, arrived at the north end of Lake Winnipeg, opposite the present site of Warren Landing, to begin construction at this first point on the proposed road. They later received help from settlers driven from the Red River colony after the massacre at Seven Oaks in 1816. The post was moved to its present location in 1826, and steadily increased in importance both as a trade depot and an administrative centre.

1816—Establishment of Swampy Lake House on the east bank of Swampy Lake. About the same time, a depot was established at The Rock, 120 miles above York Factory, up to which point fair-sized boats could be used without having to unload cargo.

1819-22—Franklin's first overland expedition, from York Factory to the mouth of Coppermine River, by way of Oxford Lake, Norway House, Saskatchewan River, and Great Slave Lake. On this and a second expedition (1825-27) he was accompanied by John Richardson, navy surgeon and naturalist. The plants collected by Richardson during the first expedition are listed in an appendix to Franklin's Narrative (1823) and are also treated in Sir William Hooker's Flora Boreali-Americana, a more easily available publication.

1820—George Simpson was requisitioned for the "Athabasca Campaign" of the Hudson's Bay Company. He and Governor Williams travelled from Norway House to The Rock, at which place he commenced his Journal (edited by Rich, 1938).

1826—Probable date of first use of York boats. These craft, pointed at both ends like a canoe, and 23 to 40 feet in length according to the routes covered, were developed in answer to Simpson's call for "a type of boat which would prove light enough to be taken on rollers over portages, strong enough to shoot the rapids, seaworthy enough to cross such stormy waterways as Lake Winnipeg, and commodious enough to carry a cargo of eighty pieces, each of which weighed ninety to one hundred pounds, as well as a crew of eight voyageurs, and to carry a sail when required." (*The Beaver*, September, 1931)

1845—John Rae, who later discovered relics of Franklin's ill-fated third expedition (1845-48), travelled via the Hayes to York Factory, setting out from there the following year for Repulse Bay to explore westward by land. A list of plants collected by Rae along the coast between York Factory and Churchill is given in his narrative (1850). The collection was named by Hooker and included in his Flora Boreali-Americana.

1857-60—Palliser's exploration of British North America between Lake Superior and the Pacific. A list of plants collected by Bourgeau in southern Manitoba is given in the 1863 report.

1875—George M. Dawson's report for the British North American Boundary Commission includes a list of plants collected during 1873-75 near the Forty-ninth Parallel. The grasses, sedges, and rushes were named by John Macoun.

1880—Robert Bell (1881) made a geological survey of the Hayes route from Norway House to York Factory. A list of the plants collected is given in an appendix by John Macoun.

1884—Bell conducted an expedition from York Factory to Hudson Strait and Labrador. A list of plants collected at York Factory is given in an appendix by John Macoun.

1885—Canadian Pacific Railway spans the continent.

1900—E. A. Preble made a biological investigation of the west coast of Hudson Bay. He reached York Factory via the Hayes. His report includes general notes on the vegetation.

1912—Extension of boundaries of Manitoba to the sixtieth parallel and to the shores of Hudson Bay to include about half of the former area of the District of Keewatin.

1931—Completion of the Hudson Bay Railway from The Pas to Churchill. It had been planned originally that the terminus should be Port Nelson, and by 1918 the right of way had been cleared and graded to this point, when construction work at Port Nelson was stopped because of a shortage of ships following the war. In 1927 work was resumed, and the track was completed to Mile 356, at which point the swing was made north to Churchill, the harbour of which provides a natural haven in the roughest of seas.

POPULATION AND INDUSTRIES

The 300-mile stretch between Norway House and York Factory is a wilderness of northern evergreen forest thinly populated by bands of Swampy Cree Indians. These gain a livelihood mainly by trapping and fishing, and in the employ of the Hudson's Bay Company. A few are employed on the steamers plying Lake Winnipeg.

The 1944 census of Indians in Canada (Indian Affairs Branch) reports the population of bands in the area as follows: Norway House, 957; Oxford House, 461; York Factory, 493. Apart from H. M. Paull's cabins on Knee Lake, the only white people are at or near the Hudson's Bay posts of Norway House (and neighbouring Rossville), Oxford House, and York Factory. The posts on Swampy Lake and at The Rock have left few traces of their former existence. Anglican, United Church, and Roman Catholic missions are maintained at Norway House, a United Church mission at Oxford House, and an Anglican mission at York Factory. Two hospitals are maintained: one at Rossville near Norway House, and one at Oxford House.

There is a small amount of agriculture on the reservations and about the posts. H. M. Paull has developed a particularly fine vegetable garden at Knee Lake. Sled dogs are fed chiefly on fish, although while the writer's party was at York Factory, several polar bear were killed for that purpose. A small amount of cordwood is cut at Norway House for use on the wood-burning S. S. *Keenora*, which makes a weekly round trip between Winnipeg and Warren Landing. Wood is also cut for fuel, although at York Factory it is cut inland and rafted down, in order to conserve the scanty growth of timber around the post.

During the party's stop at Oxford House, the annual distribution of treaty money to the Indians took place. A regatta was held the following day, followed by a game of football between whites and Indians, in which the latter, with characteristic generosity, refrained from pushing the final score to the sky's limit in their favour.

CLIMATIC DATA

Table I has been compiled from isotherm charts in A. J. Connor's "The Climate of Manitoba" (Economic Survey Board of Manitoba, 1939).

Fractions of degrees have been ignored, being difficult to assess in many cases. Figures in brackets were obtained by extrapolation but are undoubtedly a close approximation of the true value. Localities are indicated by the following column numbers: (1) Norway House; (2) Oxford House; (3) York Factory. Values are in Fahrenheit degrees.

TABLE I

Month	Average monthly mean maximum temperature			Average monthly mean minimum temperature		
	(1)	(2)	(3)	(1)	(2)	(3)
January	−1	−3	−12	−19	−25	−27
February	5	1	(−7)	−16	−22	−24
March	21	19	11	−3	(−6)	−12
April	40	38	26	18	16	9
May	56	58	44	32	31	21
June	67	64	54	44	42	34
July	74	71	66	52	49	43
August	69	68	64	49	46	..
September	57	56	53	40	38	36
October	43	41	36	28	..	(21)
November	23	21	20	9	7	5
December	6	4	−1	−10	..	(−18)

York Factory lies close to the July actual temperature isotherm of 55·4 degrees. That of the other stations is approximately 61 degrees. The Wekusko area isotherms follow closely those of Norway House.

The area is depicted by Connor as having an average total annual precipitation of 14 to 16 inches, of which 30 to 38 per cent falls as snow (50 to 60 inches).

GENERAL CHARACTER OF THE DISTRICT

From Norway House to The Rock, 120 miles above York Factory, the canoe route lies within the great Canadian Shield area of Precambrian granites and gneisses. Proceeding down the "East Channel" of the Nelson, a short portage is made at Sea River Falls, and the Echimamish, of which Hairy Lake is the only enlargement, is reached near High Rock.

Three lift-overs are necessary on the Echimamish at dams originally built by beaver but now maintained to raise the level of navigable water. A short portage over the Painted Stone leads to the headwaters of the Hayes, with its chain of Robinson, Logan, Max, Windy, Oxford, Back, Knee, and Swampy Lakes. Many rapids are encountered along the intervening stretches. These are especially numerous below Swampy Lake, where the river flows over a bed of angular blocks and jutting ledges of gneiss. About 20 miles below Swampy Lake is Brassy Hill, elevation 392 feet, the most prominent landmark in the whole low-lying area. Its name is derived from that of Brassa, an early Hudson's Bay Company employee. About 20 miles below this is the last portage, at The Rock, below which the river enters the Hudson Bay Lowland region of flat-bedded Ordovician and Silurian limestones and dolomites. Here the river winds with great regularity between clay banks 30 to 100 feet high, the only obstructions being the gravel bars formed at each bend. Fox River enters about 80 miles above York Factory, and the Shamattawa about 60 miles above. The exceptionally high banks of the lower Hayes were believed by Tyrrell (1913) to be the result of deposition by a post-glacial mud-laden stream on an underlying mantle of glacial till in which a deep embayment of the shoreline had been formed. No outcrops of bedrock occur in this stretch.

The mouth of the Hayes is obstructed by extensive flats, barring entry of supply schooners to the post except at high tide. It is separated from that of the Nelson by a low-lying neck of land, Marsh Point, near the tip of which a steel beacon has been erected as an aid to navigation. The swift currents of the two adjacent rivers, combined with the tidal currents and extensive tidal flats of the Bay, make the rounding of this point a hazardous undertaking except under favourable conditions of wind and tide.

Ascending the Nelson, the head of tide is reached near Gillam Island, a few miles above Flamborough Head. The water of the Nelson is relatively clear, its banks and bed being composed of a compact boulder-clay till and not of marine sediments. Its islands are believed to have been formed by channel diversion and not by deposition. Outcrops of dolomitic limestone are frequent, and heavily loaded canoes must be lined around points. The "Head of Navigation" for small river steamers is reached below a group of islands about 40 miles above Gillam Island, and the first of the Limestone Rapids is reached after a further 25 miles. A portage up the steep clay bank of the northwest shore leads to Mile 352 of the Hudson Bay Railway. Tyrrell notes that the lower Nelson has the appearance of having been cut out originally by a smaller stream, perhaps a former branch of Burntwood River, and that the present steep banks are due to the activity of a larger stream introduced at a later date.

The fact that the Hudson Bay Lowland has undergone considerable uplift following deglaciation is well established. Plate XXVIII, an aerial view of Marsh Point, illustrates this well in its concentric pattern of raised shore lines and corroborates the evidence along the Bay of regular lines of driftwood at levels well above the highest tides, and of numerous raised beaches in which marine shells have been found between elevations of 200 to 500 feet. Whether or not the land is at present rising at an appreciable rate is another question. Bell (1898) believed the rate of uplift in recent times to be between 5 and 10 feet per century. Gutenberg (1941), using

Marsh Point between the mouths of the Hayes and Nelson Rivers, showing the concentric pattern of raised shore lines. (*Aerial photo, courtesy Department of National Defence, Ottawa, Canada*).

tide-gauge data, supports this view. Among other points, Bell cited the following: (1) old navigation records and the increasing difficulty of reaching H.B.C. posts by schooner (an old map shows a channel crossing Marsh Point, formerly used to avoid the difficult passage around); (2) the presence of low ridges of drifted material in the woods near the head of tide water of the Nelson and at other places. (The concentric pattern of the shrub-muskeg vegetation of Marsh Point is probably largely the result of such ridges. Bell (1879) noted that in traversing this point from the sea inland, "one meets first with sedges and grasses; next comes bushes, then small trees, and finally, the full-sized timber of the country. There is much old drift-wood near the tree-line, which is now apparently never touched by water."); (3) the well-preserved nature of shells of moderately deep-water species of molluscs in the clay shores of James Bay; (4) the present inappropriateness of many of the aboriginal place-names of James Bay; (5) the drying up of salt marsh feeding grounds of ducks and geese within memory of living man; (6) the presence northward of remains of Eskimo beach dwellings up to elevations of 70 feet; (7) the appearance of trees on river islands within the memory of living man.

Tyrrell (1896), Johnston (1939), and Cooke (1942), on the other hand, believe that the post-glacial uplift has reached a condition of practical stability, and that the records of the last 200 years show rates of uplift of only a few centimeters per century, if any.

MAJOR PLANT COMMUNITIES

With the exception of the tip of Marsh Point, which is part of the narrow coastal strip of arctic tundra extending southward to James Bay, the survey route falls within the transcontinental Boreal Conifer Forest region. This has been divided by Halliday (1937) into 27 sections, of which we are concerned with the following three: (1) Nelson River Section; (2) Northern Coniferous Section; and (3) Northern Transition Section.

1. *Nelson River Section*

The 50-mile stretch from Norway House to within a few miles of Painted Stone portage at the headwaters of the Echimamish is the only part of the route formerly covered by glacial Lake Agassiz. Deposition of lacustrine clays and sands has had the effect of smoothing out original irregularities, although areas of bared rock are of frequent occurrence. The plant associations of this Section have been outlined by the writer in a previous paper (1950). The principal trees are black and white spruce, balsam poplar, aspen, tamarack, jack pine, and balsam fir.

2. *Northern Coniferous Section*

From the Painted Stone to some miles below Swampy Lake, the route continues in a part of the heavily glaciated Canadian Shield outside of the Lake Agassiz borders. The soil-cover is thin, and much of the bedrock is exposed in a pattern of parallel ridges separating poorly drained depressions. Black spruce is the dominant tree, with an admixture of jack pine on rock exposures and tamarack in the swampy depressions. Where soil conditions are more favourable, mixed stands of white spruce, white birch, balsam fir, aspen, and balsam poplar occur, although the inaccessibility of the area has thus far deterred the introduction of commercial lumbering. There is in the National Herbarium of Canada a specimen of red pine collected by Robert Bell in 1880, with the locality given as "Hill River, Hudsons Bay." (Early reports refer to various sections of the Hayes River as follows: Painted Stone to Oxford Lake, Franklin River; Back Lake to Knee Lake, Trout River; Knee Lake to Swampy Lake, Jack River; Swampy Lake to mouth of Fox River, Hill River; mouth of Fox River to mouth of Shamattawa, Steel River; mouth of Shamattawa to York Factory, Hayes River.) There are no other collections or reports to validate this number (25,184), which is far north of the main area of the western limit of this species.

3. *Northern Transition Section*

This is a zone of gradation between the typical Boreal Forest and the Arctic Tundra. As previously noted, most of this part of the route lies within the Palæozoic formations of the Hudson Bay Lowland, upon which marine sediments have been deposited. Black and white spruce, tamarack, aspen, and balsam poplar extend in the river valley to York Factory, although jack pine, balsam fir, and white birch drop out at varying distances from this point.

The following notes, summarizing part of the collections made during the survey, are intended to present a general picture of the types of vegetation developed in various ecological habitats.

NORWAY HOUSE

Shallow soil and crevices of dry granite rocks (June 17, 1949)

Cryptogramma crispa var. *acrostichoides*
Eriophorum angustifolium
Carex deflexa
Poa alpina
Corydalis sempervirens
Barbarea vulgaris var. *arcuata*
Draba nemorosa
Antennaria rosea
A. canadensis
A. microphylla
Androsace septentrionalis var. *subumbellata*
Viola palustris

MAX LAKE

Dry vertical cliffs (June 26, 1949)

Woodsia ilvensis
Lycopodium Selago

The latter, bearing the writer's number 5216, is an arctic circumpolar and alpine species new to the flora of Manitoba. It occurs in the centre of the large gap between the southern tip of James Bay and the extreme northwestern corner of Saskatchewan shown on Raup's Plate XIV in Sargentia VI, 1949.

OXFORD LAKE

Shallow water (June 28, 1949)

Ceratophyllum demersum

This is a northward extension of the range of the species in Manitoba over the previous most northerly report (Wilkins Point, Dawson Bay, Lake Winnipegosis, John Macoun, No. 24,857, July 16, 1881; specimen in the National Herbarium of Canada).

Shallow water (July 5, 1949)

Juncus subtilis
Ranunculus Flammula var. *ovalis*
R. aquatilis var. *capillaceus*
Myriophyllum exalbescens

Gravel beach and wet shore (July 2, 1949)

Equisetum arvense var. *boreale*
Alopecurus aequalis
Carex lenticularis
Eleocharis palustris var. *major*
Juncus balticus var. *montanus*
Salix pellita
S. lucida
Cerastium nutans
Ranunculus Flammula var. *filiformis*
Corydalis aurea
Cardamine pensylvanica
Rorippa islandica var. *Fernaldiana*
Arabis hirsuta var. *pycnocarpa*
Ribes hudsonianum
Potentilla norvegica
P. Anserina
Geranium Bicknellii
Hippuris vulgaris
Cicuta maculata
Cornus stolonifera
Mentha arvensis var. *villosa* f. *glabrata*
Senecio congestus var. *palustris*

Black spruce–tamarack muskeg forest (July 3, 1949)

Equisetum scirpoides
E. arvense
var. *boreale*
E. sylvaticum
var. *pauciramosum*
E. fluviatile
f. *Linnaeanum*
Picea mariana
Larix laricina
Abies balsamea
Eriophorum viridicarinatum
Carex chordorrhiza
C. rostrata
var. *utriculata*
C. diandra
C. limosa
C. aquatilis
C. disperma
C. gynocrates
Smilacina trifolia
Salix myrtillifolia
S. MacCalliana
S. Bebbiana
S. candida
S. pedicellaris
var. *hypoglauca*
Betula glandulosa
B. papyrifera
var. *neoalaskana*
Alnus incana
ssp. *rugosa*
Stellaria longifolia
Drosera rotundifolia
Mitella nuda
Rubus Chamaemorus
R. acaulis
Potentilla palustris
Oxycoccus microcarpus
O. quadripetalus
Vaccinium Vitis-Idaea
var. *minus*
Ledum groenlandicum
Chamaedaphne calyculata
Pyrola secunda
Kalmia polifolia
Andromeda glaucophylla
Solidago multiradiata

Conifer woods with thin soil on granitic rock (July 1-5, 1949)

Equisetum sylvaticum
var. *pauciramosum*
Lycopodium tristachyum
L. obscurum
Picea glauca
Larix laricina
Carex deflexa
C. Deweyana
Luzula parviflora
Maianthemum canadense
var. *interius*
Cypripedium passerinum
C. Calceolus
var. *parviflorum*
Corallorhiza trifida
Populus tremuloides
Betula papyrifera
var. *neoalaskana*
Anemone multifida
var. *hudsoniana*
f. *sanguinea*
Rubus pubescens
R. acaulis
Prunus pensylvanica
Fragaria ?yukonensis
Shepherdia canadensis
Aralia nudicaulis
Cornus canadensis
Ledum groenlandicum
Arctostaphylos rubra
A. Uva-ursi
var. *coactilis*
Pyrola minor
Vaccinium myrtilloides
V. Vitis-Idaea
var. *minus*
Apocynum androsaemifolium
Linnaea borealis
var. *americana*
Lonicera glaucescens
L. involucrata
Petasites palmatus
Erigeron hyssopifolius
var. *typicus*

Rocky island (July 2, 1949)

Salix Bebbiana
S. planifolia
S. MacCalliana
Populus balsamifera
Betula glandulosa
Alnus incana
ssp. *rugosa*
Cerastium nutans
Corydalis sempervirens
Rorippa islandica
var. *Fernaldiana*
Draba nemorosa
Arabis divaricarpa
Cardamine pensylvanica
Ribes triste
R. glandulosum
R. oxyacanthoides
Saxifraga tricuspidata
Potentilla tridentata
Rubus strigosus
R. acaulis
Cornus canadensis
Vaccinium myrtilloides
V. Vitis-Idaea
var. *minus*
Achillea nigrescens

Cleared land near Hudson's Bay post (June 30-July 3, 1949)

Equisetum arvense
E. pratense
Botrychium Lunaria
Juniperus communis
var. *depressa*
Hierochloe odorata
Elymus innovatus
Poa alpina
Carex aenea
Allium Schoenoprasum
var. *sibiricum*
Sisyrinchium montanum
Salix planifolia
S. pellita
S. candida
S. Bebbiana
Populus balsamifera
Alnus incana
ssp. *rugosa*
A. crispa
Urtica gracilis
Polygonum achoreum
Rumex triangulivalvis
Chenopodium album
Stellaria media
S. longifolia
Arenaria lateriflora
Anemone canadensis
A. multifida
var. *hudsoniana*
f. *sanguinea*
Ranunculus Macounii
Aquilegia brevistyla
Caltha palustris
Actaea rubra
Thalictrum venulosum
Capsella Bursa-pastoris
Arabis hirsuta
var. *pycnocarpa*
Ribes hudsonianum
R. oxyacanthoides
R. triste
Heuchera hispida
Potentilla Anserina
Rosa acicularis
Fragaria ?yukonensis
Rubus strigosus
Geum aleppicum
var. *strictum*
Amelanchier alnifolia
Trifolium repens
Vicia americana
Lathyrus ochroleucus
Geranium Bicknellii
Epilobium angustifolium
Carum Carvi
Cornus stolonifera
Gentiana acuta
Rhinanthus groenlandicus
Plantago major
Galium boreale
Viburnum edule
Symphoricarpos albus
Lonicera involucrata
Antennaria rosea
Achillea nigrescens
Senecio pauperculus
Taraxacum officinale
T. ?dumetorum

KNEE LAKE

In addition to the majority of the species in similar habitats at Oxford Lake, the following were collected:

Gravel beach and wet shore (July 8, 1949)

Calamagrostis canadensis
Agropyron trachycaulum
var. *typicum*
Hordeum jubatum
Eleocharis acicularis
var. *typica*
Juncus tenuis
Salix MacCalliana
Polygonum amphibium
var. *stipulaceum*
P. amphibium
var. *stipulaceum*
f. *fluitans*
Rumex fueginus
R. triangulivalvis
Ranunculus pensylvanicus
Rorippa islandica
var. *hispida*
Potentilla Anserina
f. *sericea*
Epilobium glandulosum
var. *adenocaulon*
Mentha arvensis
var. *villosa*
f. *typica*
Stachys palustris
var. *pilosa*
Veronica peregrina
ssp. *xalapensis*
Plantago major
Galium trifidum

Rocky islands (July 8, 1949)

Cystopteris fragilis
Woodsia ilvensis
Pinus Banksiana
Abies balsamea
Juniperus communis
var. *depressa*
Agrostis scabra
Poa glauca
P. alpina
Carex Bebbii
Salix pellita
Populus tremuloides
Urtica gracilis
Chenopodium capitatum
Arenaria dawsonensis
Stellaria calycantha
Arabis hirsuta
var. *pycnocarpa*
Potentilla norvegica
Amelanchier alnifolia
Shepherdia canadensis
Cornus stolonifera
Gentiana acuta
Mertensia paniculata
Artemisia caudata
Solidago hispida
Achillea sibirica

Conifer woods (July 7, 1949)

Lycopodium complanatum
Equisetum pratense
Abies balsamea
Carex disperma
C. brunnescens
Populus balsamifera
Alnus crispa
Geocaulon lividum
Ribes lacustre
R. hudsonianum
Lathyrus ochroleucus
Pyrola virens
P. asarifolia
P. secunda
Arctostaphylos Uva-ursi
var. *adenotricha*
Mertensia paniculata
Galium trifidum
Vibernum edule

PLATE XXIX

Hayes River at The Rock.

THE ROCK

Shallow water (July 15, 1949)

Potamogeton Richardsonii
P. Friesii
P. filiformis
P. gramineus
var. *typicus*
P. alpinus
var. *tenuifolius*
Sagittaria cuneata
Hippuris vulgaris
f. *fluviatilis*

Gravel beach and wet shore (July 15, 1949)

The following species were collected, in addition to many of those already listed for the shore habitat at Oxford Lake and Knee Lake. The three lists together will furnish a fairly complete picture of the shore vegetation of the Precambrian region. Typical of this habitat, characterized by a minimum of competition from species of the climax forest, is the presence of many pioneer shrubs and plants of a "weedy" nature, in addition to the normal helophytes.

Equisetum arvense
E. palustre
Glyceria striata
var. *stricta*
Poa trivialis
Sphenopholis pallens
Deschampsia caespitosa
var. *glauca*
Agrostis scabra
Calamagrostis inexpansa
var. *brevior*
Bromus ciliatus
Beckmannia Syzigachne
Salix pseudomonticola
S. Bebbiana
S. myrtillifolia
Populus balsamifera
Alnus incana
ssp. *rugosa*
Thalictrum venulosum
Erysimum cheiranthoides
Potentilla fruticosa
Amelanchier alnifolia
Geum aleppicum
var. *strictum*
Rubus pubescens
R. strigosus
Rosa acicularis
Fragaria glauca
Vicia americana
Shepherdia canadensis
Epilobium angustifolium
Sium cicutaefolium
Gentiana acuta
Galium boreale
Hieracium canadense
Aster junceus
Solidago canadensis

Conifer woods (July 13, 1949)

The following list, again, represents additions to those already recorded for the upland conifer formation at Oxford and Knee Lakes. Together with these, it will be fairly representative of the habitat. Certain atypical elements will be recognized as resulting from disturbances in the original forest cover.

Carex vaginata
Elymus innovatus
Poa alpigena
Orchis rotundifolia
Salix vestita
S. myrtillifolia
S. Bebbiana
S. planifolia
S. pseudomonticola
Alnus incana
ssp. *rugosa*
Arenaria lateriflora
Actaea rubra
Thalictrum sparsiflorum
var. *Richardsonii*
Mitella nuda
Ribes triste
R. oxyacanthoides
Rosa acicularis
Geum macrophyllum
var. *perincisum*
Astragalus frigidus
var. *americanus*
Vicia americana
Rhamnus alnifolia
Epilobium angustifolium
Cornus stolonifera
Moneses uniflora
Galium boreale
Symphoricarpos albus
Senecio pauperculus
Erigeron acris
var. *elatus*
Petasites vitifolius
Solidago multiradiata

The shaded, cool, mossy banks of a small stream flowing through the woods and entering the Hayes at The Rock had the following interesting flora (July 14, 1949):

Equisetum scirpoides
Triglochin palustris
Poa alpigena
Hierochloe odorata
Glyceria striata
var. *stricta*
Scirpus rubrotinctus
Eriophorum brachyantherum
Carex aurea
C. capillaris
var. *major*
C. gynocrates
C. disperma
C. media
C. rostrata
var. *utriculata*
Habenaria obtusata
H. hyperborea
Caltha palustris
Anemone parviflora
Ranunculus lapponicus
Rorippa islandica
var. *Fernaldiana*
Parnassia palustris
var. *neogaea*
Epilobium palustre
E. glandulosum
var. *adenocaulon*
Petasites vitifolius

The banks of this stream were composed of frozen clay, the seepage water of which had a temperature of 40°F. The water of the stream itself had a temperature of 55°F., and that of the Hayes was 65°F. It is questionable, however, whether permanently frozen ground is at all extensive at this point, although it is known to have an average depth of about 30 feet at Port Nelson. Johnston (1930) points out that "This suggests that there is also frozen ground at York Factory near the mouth of the Hayes river, a few miles to the southeast, and it is reported that coffins containing bodies over 200 years old that were well preserved by being frozen were exposed on the bank of the river at York as a result of river erosion of the bank." Bell (1879) notes, concerning the Steel and the Hayes, that "There is certainly evidence of the existence of frost in banks of these rivers and under the peaty layers above them in the month of July, but it is known that in southern parts of the Dominion the frost penetrates to a greater depth into the face of exposed banks than into the level ground, and is frequently found in such situations in the middle of summer."

Lightly wooded clay banks above the stream supported the following vegetation (July 14, 1949):

Lycopodium complanatum
Pinus Banksiana
Picea glauca
Juniperus horizontalis
J. communis
var. *depressa*
Elymus innovatus
Poa glauca
Carex concinna
Cypripedium passerinum
C. Calceolus
var. *parviflorum*
Habenaria hyperborea
H. viridis
var. *interjecta*
Salix Bebbiana
S. myrtillifolia
Populus tremuloides
Betula papyrifera
var. *neoalaskana*
Alnus crispa
Geocaulon lividum
Arenaria dawsonensis
Anemone parviflora
A. multifida
var. *hudsoniana*
f. *sanguinea*
Amelanchier alnifolia
Prunus pensylvanica
Fragaria glauca
Ledum groenlandicum
Arctostaphylos rubra
A. Uva-ursi
var. *adenotricha*
Chamaedaphne calyculata
Vaccinium Vitis-Idaea
var. *minus*
Pyrola secunda
Galium boreale
Arnica lonchophylla
ssp. *genuina*
Achillea Millefolium
Petasites palmatus
Solidago hispida
S. multiradiata
Senecio pauperculus
Erigeron acris
var. *elatus*
E. hyssopifolius
var. *typicus*

The remaining notes deal with the vegetation of the Palæozoic formations of the Hudson Bay Lowland section of the Hayes and Nelson Rivers, followed by a brief reference to some of the more interesting species of the Wekusko and Tramping Lakes area.

HAYES RIVER OPPOSITE MOUTH OF FOX RIVER

Clay-gravel-cobble beach (July 17, 1949)

This habitat is very similar to the one illustrated in Plate XXX.

Equisetum arvense
E. palustre
Hierochloe odorata
Hordeum jubatum
Elymus innovatus
Trisetum spicatum
Sphenopholis pallens
Agropyron trachycaulum
var. *typicum*
Glyceria striata
var. *stricta*
Agrostis scabra
Poa alpina
P. alpigena
Calamagrostis neglecta
Beckmannia Syzigachne
Carex aurea
C. lanuginosa
Juncus balticus
var. *montanus*
Smilacina stellata
Sisyrinchium montanum
Habenaria hyperborea
Salix pseudomonticola
S. interior
Populus tremuloides
P. balsamifera
Alnus incana
ssp. *rugosa*
Anemone canadensis
Thalictrum venulosum
Parnassia palustris
var. *neogaea*
Rosa acicularis
Rubus acaulis
Potentilla fruticosa
P. Anserina
f. *sericea*
Vicia americana
Lathyrus palustris
Rhamnus alnifolia
Elaeagnus commutata
Epilobium angustifolium
Heracleum lanatum
Cornus stolonifera
Mertensia paniculata
Dracocephalum parviflorum
Castilleja Raupii
ssp. *typica*
Euphrasia ?arctica
Rhinanthus groenlandicus
Pedicularis groenlandica
Plantago major
Galium boreale
Senecio pauperculus
Taraxacum ?dumetorum
Hieracium canadense
Solidago graminifolia
var. *camporum*
S. canadensis
Achillea Millefolium
Lactuca pulchella
Aster junceus
Artemisia biennis
Erigeron hyssopifolius
var. *typicus*
Antennaria pulcherrima
Tanacetum huronense
var. *bifarium*
Prenanthes racemosa

A similar habitat (Plate XXX) about 40 miles down river had the following species, in addition to many of the above (July 18, 1949):

Tofieldia glutinosa
Habenaria viridis
var. *interjecta*
Betula glandulosa
Polygonum viviparum
Anemone parviflora
A. multifida
var. *hudsoniana*
f. *sanguinea*
Hedysarum Mackenzii
Oxytropis campestris
Artemisia canadensis
Arnica alpina
ssp. *angustifolia*

Gravel-cobble floodplain of island in the Hayes River, about 40 miles above York Factory.

The following species were collected on a clay beach of the Hayes about 20 miles above York Factory (July 18, 1949):

Catabrosa aquatica
Eriophorum Scheuchzeri
E. angustifolium
Carex vaginata
Juncus castaneus
Allium Schoenoprasum var. *sibiricum*
Salix vestita
Stellaria longipes
Sagina nodosa
Descurainia sophioides
Primula incana
Achillea nigrescens

YORK FACTORY

All of the collections made at York Factory are included in the following lists:

Gravel-cobble beach and floodplain of Hay Island, Hayes River, opposite H.B.C. post (July 24, 1949)

Equisetum arvense
E. variegatum
E. fluviatile
f. *Linnaeanum*
Triglochin palustris
Poa alpina
Deschampsia caespitosa
var. *littoralis*
Festuca rubra
var. *arenaria*
Agropyron trachycaulum
var. *typicum*
Trisetum spicatum
Hierochloe odorata
Eriophorum Scheuchzeri
Eleocharis palustris
Carex aquatilis
Juncus Gerardi
J. balticus
var. *littoralis*
J. albescens
J. castaneus
Allium Schoenoprasum
var. *sibiricum*
Habenaria hyperborea
H. viridis
var. *interjecta*
Salix lucida
S. myrtillifolia
S. pellita
S. lutea
S. candida
S. interior
S. calcicola
Populus balsamifera
Alnus incana
ssp. *rugosa*
Polygonum viviparum
Stellaria longipes
Anemone canadensis
Parnassia palustris
var. *neogaea*
Potentilla fruticosa
P. Anserina
f. *sericea*
Vicia americana
Lathyrus palustris
Astragalus goniatus
Epilobium angustifolium
Primula incana
P. mistassinica
var. *typica*
P. egaliksensis
f. *violacea*
Gentiana acuta
Castilleja Raupii
ssp. *typica*
Euphrasia ?arctica
Pedicularis groenlandica
Pinguicula vulgaris
Galium boreale
Erigeron hyssopifolius
var. *typicus*
Artemisia canadensis
Senecio pauperculus
Tanacetum huronense
var. *bifarium*
Solidago multiradiata
Taraxacum ?dumetorum
Achillea nigrescens
Hieracium canadense
Solidago graminifolia
var. *camporum*

Clay flats above high tide, Marsh Point (July 25, 1949)

Triglochin palustris
T. maritimum
Festuca rubra
Calamagrostis neglecta
C. deschampsioides
Elymus arenarius
Hordeum jubatum
Dupontia Fisheri
f. *psilosantha*
Puccinellia distans
Eleocharis palustris
var. *typica*
E. uniglumis
Eriophorum angustifolium
Carex paleacea
C. saxatilis
var. *miliaris*
Salix brachycarpa
S. candida
Rumex occidentalis
Ranunculus Cymbalaria
Parnassia palustris
var. *neogaea*
Potentilla Egedii
var. *groenlandica*
Primula egaliksensis
Euphrasia ?arctica
Rhinanthus groenlandicus
Castilleja Raupii
ssp. *typica*
Plantago juncoides
var. *decipiens*
Chrysanthemum arcticum

Several of the above species are definitely halophytic, although on account of the great discharge of fresh water into the Bay, the water off the Point is not salty to the taste. It will be recalled that the tip of Marsh Point falls within the narrow coastal strip of arctic tundra. This is reflected especially by the presence of *Calamagrostis deschampsioides*, *Dupontia Fisheri* f. *psilosantha*, and *Chrysanthemum arcticum*, all of which extend in this zone to James Bay, but there reach their southern limit. The habitat is illustrated in Plate XXXI.

PLATE XXXI

Beach near tip of Marsh Point, a few miles below York Factory.

Black spruce-tamarack muskeg forest near steel beacon, Marsh Point (July 25, 1949)

Triglochin maritimum
Eriophorum angustifolium
Habenaria hyperborea
Cypripedium passerinum
Luzula parviflora
Salix cordifolia
var. *Macounii*
S. reticulata
Betula glandulosa
Ranunculus Gmelinii
var. *Hookeri*
Potentilla palustris
Shepherdia canadensis
Epilobium palustre
Pyrola asarifolia
var. *purpurea*
Hippuris vulgaris
Galium trifidum
Petasites sagittatus
Erigeron acris
var. *elatus*
Solidago multiradiata

Large landslide and erosion gully in clay banks of Hayes River, 3 miles above H.B.C. post (July 26-28, 1949)

Equisetum palustre
Triglochin palustris
Catabrosa aquatica
Beckmannia Syzigachne
Poa alpigena
P. trivialis
Hordeum jubatum
Calamagrostis canadensis
C. canadensis
var. *robusta*
Agrostis scabra
Glyceria grandis
Eriophorum Scheuchzeri
Scirpus rubrotinctus
Carex gynocrates
Juncus Gerardi
J. balticus
var. *littoralis*
J. castaneus
J. nodosus
J. bufonius
Luzula parviflora
Salix reticulata
S. candida
S. pedicellaris
var. *hypoglauca*
Betula glandulosa
Rumex triangulivalvis
Chenopodium glaucum
C. album
C. capitatum
Stellaria longipes
S. longifolia
S. crassifolia
S. calycantha
Sagina nodosa
Arenaria dawsonensis
Ranunculus Cymbalaria
R. pensylvanicus
R. sceleratus
R. Macounii
Rorippa islandica
var. *Fernaldiana*
Arabis arenicola
Descurainia sophioides
Ribes hudsonianum
Parnassia palustris
var. *neogaea*
Potentilla palustris
P. norvegica
P. Anserina
Vicia americana
Epilobium angustifolium
E. palustre
E. glandulosum
var. *adenocaulon*
Sium cicutaefolium
Veronica peregrina
ssp. *xalapensis*
Castilleja Raupii
ssp. *typica*
Rhinanthus groenlandicus
Euphrasia ?arctica
Plantago major
Achillea nigrescens
Erigeron hyssopifolius
var. *typicus*
Artemisia biennis
A. canadensis
Aster junceus
A. puniceus
Solidago canadensis
Taraxacum sp.

The following were collected in shallow water of pools in the broken surface of the gully floor:

Potamogeton Richardsonii
P. strictifolius
var. *rutiloides*
P. filiformis
P. gramineus
var. *typicus*
Sagittaria cuneata
Catabrosa aquatica
Alopecurus aequalis
Eleocharis acicularis
var. *typica*
Carex paupercula
var. *irrigua*
C. aquatilis
Ranunculus aquatilis
var. *capillaceus*
R. Flammula
var. *filiformis*
R. Gmelinii
var. *Hookeri*
Callitriche palustris
Hippuris vulgaris
Limosella aquatica

Black spruce–tamarack muskeg forest near H.B.C. post (July 22-26, 1949)

Equisetum arvense
Picea mariana
Larix laricina
Poa alpigena
Luzula parviflora
Orchis rotundifolia
Cypripedium passerinum
Salix myrtillifolia
S. planifolia
Betula glandulosa
Geocaulon lividum
Mitella nuda
Ribes hudsonianum
Rubus Chamaemorus
Empetrum nigrum
Shepherdia canadensis
Vaccinium Vitis-Idaea
var. *minus*
V. uliginosum
Pyrola secunda
Moneses uniflora
Ledum groenlandicum
Arctostaphylos rubra
Andromeda Polifolia
Kalmia polifolia
Chamaedaphne calyculata
Castilleja Raupii
ssp. *typica*
Pinguicula vulgaris
Galium labradoricum
Erigeron acris
var. *elatus*

Several of the above will be recognized as atypical elements, being intruders along the border of the forest at the edge of the clay river banks. Moist or wet depressions in the forest harboured the following species:

Equisetum fluviatile
f. *Linnaeanum*
Sparganium angustifolium
Potamogeton alpinus
var. *tenuifolius*
Triglochin maritimum
Lemna trisulca
Eriophorum viridicarinatum
E. Scheuchzeri
E. angustifolium
Carex diandra
C. limosa
C. chordorrhiza
C. tenuiflora
Smilacina trifolia
Habenaria hyperborea
H. obtusata
Listera cordata
Salix candida
S. pedicellaris
var. *hypoglauca*
Polygonum viviparum
Rumex triangulivalvis
Parnassia palustris
var. *neogaea*
Saxifraga Hirculus
Potentilla palustris
Epilobium palustre
Cicuta maculata
Oxycoccus microcarpus
Menyanthes trifoliata
Pedicularis palustris
Utricularia vulgaris
U. intermedia

Wet mossy edge of stream near H.B.C. post, York Factory (July 22, 1949)

Caltha palustris
Ranunculus Macounii
R. Gmelinii
var. *Hookeri*
Cardamine pratensis

Upland conifer woods near H.B.C. post, York Factory (July 22, 1949)

Equisetum arvense
Picea glauca
Carex rostrata
var. *utriculata*
Salix vestita
S. cordifolia
var. *Macounii*
S. MacCalliana
S. myrtillifolia
S. Bebbiana
Populus balsamifera
Betula glandulosa
Alnus incana
ssp. *rugosa*
Rumex triangulivalvis
Actaea rubra
Thalictrum sparsiflorum
var. *Richardsonii*
Ribes triste
var. *albinervium*
R. oxyacanthoides
R. hudsonianum
Shepherdia canadensis
Viburnum edule
Valeriana septentrionalis

Open ground and clearings by H.B.C. post, York Factory (July 20, 1949)

Equisetum arvense
Festuca rubra
F. rubra
var. *arenaria*
Hordeum jubatum
Deschampsia caespitosa
var. *littoralis*
Calamagrostis canadensis
Hierochloe odorata
Beckmannia Syzigachne
Poa alpina
Eriophorum Scheuchzeri
Carex incurva
C. aurea
C. capillaris
var. *major*
C. aquatilis
Juncus balticus
Luzula sudetica
Habenaria hyperborea
Salix candida
S. cordifolia
var. *Macounii*
S. serissima
S. myrtillifolia
Urtica gracilis
Polygonum viviparum
Rumex occidentalis
Stellaria longipes
S. media
S. graminea
Arenaria lateriflora
Thalictrum venulosum
Ranunculus acris
R. Macounii
R. Cymbalaria
Actaea rubra
Erysimum cheiranthoides
Rorippa islandica
var. *Fernaldiana*
Capsella Bursa-pastoris
Parnassia palustris
var. *neogaea*
Ribes oxyacanthoides
Geum macrophyllum
var. *perincisum*
Fragaria sp.
Potentilla Anserina
P. pectinata
Rubus acaulis
Vicia Cracca
Epilobium angustifolium
E. glandulosum
var. *adenocaulon*
Carum Carvi
Heracleum lanatum
Primula incana
Mertensia paniculata
Castilleja Raupii
ssp. *typica*
Euphrasia ?arctica
Rhinanthus groenlandicus
Petasites sagittatus
Achillea nigrescens
Taraxacum ?dumetorum
Solidago multiradiata
Erigeron acris
var. *elatus*

NELSON RIVER

The vegetation up the Nelson to Limestone Rapids is very similar to that of the parallel Hayes River section, and like the latter is characterized by the presence of numerous calciphilous species. The following additional species, however, were collected:

Gravel-cobble beach opposite Gillam Island (July 30, 1949)

Carex bicolor
Epilobium latifolium
Artemisia Tilesii

Gravel-cobble beach about 10 miles above Gillam Island (July 30, 1949)

Salix glauca
var. *acutifolia*

Gravel-cobble beach near mouth of Roblin River (July 31, 1949)

Botrychium Lunaria
Carex scirpoidea

Woods near mouth of Roblin River (July 31, 1949)

Carex eburnea

Clay banks of Nelson near "Head of Navigation" (July 31, 1949)

Arnica alpina
ssp. *attenuata*

Open ground and clearings at Limestone Rapids (August 2-3, 1949)

Salix arbusculoides
Arabis Holboellii
Descurainia Sophia
D. Richardsonii
ssp. *typica*
Erigeron acris
var. *asteroides*
Matricaria suaveolens

WEKUSKO LAKE—TRAMPING LAKE

The vegetation of this area, near the western boundary of Halliday's Nelson River Section, does not differ radically from that of the Norway House area. Following, however, are the names of species collected only in this area and absent from the foregoing lists.

Shallow water and muddy edges of pools and ditches (August 15-20, 1949)

Sparganium chlorocarpum
Potamogeton pectinatus
Alisma subcordatum
Anacharis canadensis
Phalaris arundinacea
Glyceria borealis
Eriophorum gracile
Spiranthes Romanzoffiana
Rumex orbiculatus
Stellaria crassifolia
Caltha natans

Granite cliffs by lake (August 12-13, 1949)

Potentilla multifida
P. pectinata
P. arguta
Pyrus decora
Artemisia frigida

Limestone cliffs at south end of Wekusko Lake (August 12, 1949)

Woodsia glabella
Phegopteris Robertiana

Limestone cliffs at south end of Tramping Lake (August 23, 1949)

Carex Richardsonii
Salix discolor
Rosa Woodsii

Roadsides and clearings (August 7-13, 1949)

Carex sychnocephala
C. praticola
C. Crawfordii
Chenopodium hybridum
var. *gigantospermum*
Axyris amaranthoides
Brassica Kaber
var. *Schkuhriana*
Trifolium hybridum
Geranium carolinianum
Impatiens capensis
Aralia hispida
Cicuta bulbifera
Collomia linearis
Cynoglossum boreale
Echinocystis lobata
Bidens cernua
Senecio vulgaris
Helianthus Maximiliani
Helenium autumnale
Antennaria neodioica
Erigeron philadelphicus
Sonchus arvensis
var. *glabrescens*
Conyza canadensis
Ambrosia trifida

Same habitat (August 15, 1949)

Carex umbellata
var. *brevirostris*
C. deflexa
Actaea rubra
f. *neglecta*
Trientalis borealis
f. *pluriverticillata*
Phacelia Franklinii
Artemisia Absinthium

Same habitat (August 23, 1949)

Silene noctiflora
Diplotaxis muralis
Impatiens pallida

CONCLUSION

Approximately 6,000 sheets of plant specimens were obtained, representing 1,721 collections of 435 species and numerous varieties of vascular plants at different localities. About 45 per cent of these show considerably increased northward extension in Manitoba over previously published reports. Thirty-three of the entities appear to have been previously unrecorded for the province. A more detailed treatment of these and of the species reported in the above lists is reserved for a flora of Manitoba, which is in the course of preparation by the writer. About 10 per cent of the species were not previously represented in the Manitoba collections of the National Herbarium, and a further 10 per cent is of species first added to the general collection following the 1948 field season in the northern Lake Winnipegosis and Norway House–Cross Lake areas. In addition to vascular plants, 138 collections of cryptogams were made, as well as collections of small birds and mammals for the zoological section of the National Museum.

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BIOLOGICAL INVESTIGATION ON THE 1949 FOXE BASIN EXPEDITION

By W. K. W. Baldwin

An expedition to the group of uncharted islands in Foxe Basin was organized by the Geographical Bureau for the summer of 1949. The National Museum provided a staff botanist to accompany the party and some of the equipment and supplies for biological collecting. The following is a brief summary of the biological work of the expedition. More detailed accounts are in course of preparation.

Besides Mr. T. H. Manning, leader of the party, the Geographical Bureau was represented by three geographers—Messrs. R. W. Packer, D. B. Coombs, and C. L. Merrill. In addition, the party included a geologist, Mr. C. A. Burns, and the botanist from the Museum, Mr. W. K. W. Baldwin. The official cook for the party wasAndrew Macpherson, who also assisted Mr. Manning in the collection and preparation of bird and mammal specimens.

Manning, Baldwin, and Macpherson preceded the party to the rendezvous at Moosonee on June 13. While awaiting the arrival of the boat and the rest of the field party, they set up camp on Sandy Island at the mouth of the Moose River. Here they carried out biological investigations in the Moose River estuary, supplementary to work done in that area in 1947 by an expedition jointly sponsored by the National Museum of Canada and the Arctic Institute of North America. In addition, some assistance was given to Packer in his geographical study of the area.

The remaining members of the party reached Moosonee on June 17 and 20, where they established headquarters. On June 22 the boat arrived at railhead after the long trip on a flatcar from its builders' yards at Upper LaHavre, Nova Scotia. Named *Nauja*, this new Canadian Government Motor Vessel had both sails and an 85 HP diesel motor. The *Nauja* had a speed of about 8 knots and was equipped with radio and a depth recorder. Launching was slow and difficult from the railway siding over the steep river bank to tidewater in the Moose River estuary. Immediately following outfitting and loading, the party left Moosonee on July 8.

Investigations on several islands in James Bay occupied most of July. Camps were set up for four-day stops at Gasket Shoal (July 9) and Solomon's Temple Island (July 14).

These islands provided a striking contrast. Gasket Shoal is low and sandy with a characteristic strand vegetation. Only a few clumps of willows and junipers occur in the low sand and gravel ridges in the centre of the island. There are no trees nor any pools or lagoons. The island supports large nesting colonies of gulls, terns, and eider ducks. Nitrophilous plants were found around these nesting sites. The flora is not rich in species. In contrast, Solomon's Temple is a high rocky island with less vegetation but a flora richer in species. There are many small pools. A few clumps of very much dwarfed spruce were found, the white spruce erect and 5 feet in height, the black spruce low and shrubby rising scarcely a foot in height.

Landings were made at South Twin Island (July 13 and 18) and Sunday Island (July 23). During four days of storm and bad weather the *Nauja* was sheltered in a narrow anchorage at the south end of Bear Island (July 19) where the party went ashore for short excursions.

Proceeding to the east coast of Hudson Bay, we established a five-day camp on the east side of Long Island (July 25). Here the route again touched that of the 1947 expedition ("Botanical Investigations on the East Coast of Hudson and James Bays"; Nat. Mus., Canada, Bull. 113, 1949, pp. 31, 32). Fine weather made it possible to travel quickly northwards inside the island chains off this well-protected coast. Overnight stops were made at Great Whale River, Duck Island, Langland River, Port Harrison, Elsie Island, Cape Smith Island, and Peck's Harbour. Time permitted botanical collections only at Elsie Island (August 3), Cape Smith Island (August 5), and at the spectacular murre nesting cliffs on Digges Island (August 8).

Crossing Hudson Strait, a call was made at Nottingham Island and a one-day camp at Putnam Island (August 10). The southwest coast of Baffin Island was reached on August 11, where a three-day camp was made at King Charles Cape while the *Nauja* picked up fuel oil and supplies at the Hudson's Bay Company post at Cape Dorset.

Continuing through Foxe Channel on August 13, the party detoured eastward around an extensive field of ice before heading north for the first of the uncharted islands. This is the largest island of the group and has been officially named Prince Charles Island. A camp was established on August 15 at the south end for a period of four days. The island is low-lying, dotted with lakes, and surrounded by extensive tidal flats.

A second camp was set up at the northern end of Prince Charles Island for a two-day stay beginning August 20. In this area the disintegrating surface of the limestone bedrock was exposed, but the surface is flat and low-lying, as at the south end.

On August 22, ice began moving in on the open anchorage, and the party went aboard and moved over to the second largest uncharted island, now officially named Air Force Island. Here a camp was made for a five-day period beginning August 23. Snow fell during the first night, and the vegetation had a full autumnal aspect. Behind the low foreshore there is a raised beach at 25 to 30 feet above sea-level, and beyond this beach are hills of Precambrian granite rocks rising 135 feet above sea-level. These have a markedly different flora from the predominantly low-lying wet areas of these islands. This was the highest land seen on the two islands.

The three landings made on Prince Charles Island and Air Force Island gave good samples of the flora of the area as far as could be judged by coastal observation and a study of air photographs. The collections of plants were believed to be fully representative of the relatively few species in the flora of these islands.

Leaving Air Force Island the members of the party divided into three camps: at Anderson Island, and at Baird Peninsula and Piling on Baffin Island. The last collections of herbarium specimens were made at Piling on September 2. Further botanical work was restricted to collecting seeds, lichens, and making general observations on the vegetation where it was not covered by snow.

Geographical studies continued in Foxe Basin for two weeks more. Landings were made at Spicer Island, Rowley Island, near Ignerit Point on Baffin Island, and Calthorpe Island. On September 14, the expedition reached the Hudson's Bay Company post at Igloolik where supplies were taken on for the return journey southwards.

Leaving Igloolik on September 15, the expedition kept to the west side of Foxe Basin along the Melville Peninsula with landings at Cape Jermain and Barrow River. After a stop near Cape Martineau, the party proceeded through Hurd Channel to White Island and thence to the Hudson's Bay Company post at Repulse Bay. Here sufficient fuel oil was taken on board to complete the voyage. Coming south by Roes Welcome Sound, stops were made at Battery Bay on Southampton Island and at Douglas Harbour about 70 miles inside Wager Bay. After one more stop in Roes Welcome Sound, the party continued to Fullerton Harbour and to the Hudson's Bay Company post at Chesterfield. A camp was set up at Marble Island from September 28-30, and for the following three days of stormy weather, shelter was found in the lea of Morso Island. The final run south brought the party to Churchill on October 5. Here the *Nauja* was hoisted onto the dock, and the expedition returned to Ottawa by train.

The *Nauja* logged about 4,000 miles to cover the itinerary outlined above. The travelling necessary to complete the geographical work, combined with the shortness of the botanical collecting season, left little opportunity for intensive biological studies of any one area. To make best use of the time available in this sort of expedition, Mr. Manning established his headquarters on board the *Nauja* for work on birds and small mammals. With his assistant, Macpherson, he made excursions ashore whenever possible. Baldwin took his botanical gear ashore and usually set up camp with Coombs. Coombs and Baldwin were joined by Packer and by Burns for their geographical and geological work ashore, and by Merrill after he had taken care of the boat's engine. While carrying out their own work, Coombs and Baldwin also assisted in taking tide readings and making other measurements of geographical nature. While travelling in the boat, all hands took equal share of the watches under the captaincy of Mr. Manning.

Approximately 240 specimens of mammals and 356 specimens of birds were collected for the National Museum. Ectoparasites were obtained for the Department of Agriculture from about 40 hosts.

The collection of vascular plants amounted to 2,700 sheets of 650 collection numbers, representing 370 species from points visited in the journey from Moose River estuary to Foxe Basin. In addition, the botanist made a collection of seeds from a number of stations in Foxe Basin for genetic studies of the Arctic Poppy. At the request of the Dominion Observatory, the botanist collected samples of arctic rock lichens for spectroscopic examination, whenever time allowed. A small collection of insects was made for the Division of Entomology of the Department of Agriculture. Notes and observations were supplemented by approximately 250 photographs taken by the botanist. These have been annotated and deposited in the files of the National Museum and the Geographical Bureau.

Acknowledgment is gratefully made to the many persons who helped in the biological work of this expedition. Thanks are given first to the geographical and geological members of the field party for their help and many kindnesses. The co-operation of the staff of the Geographical Bureau and of the government services involved in outfitting the expedition is also gratefully acknowledged. Finally, the assistance of the personnel of the Hudson's Bay Company was much appreciated.

FOREST-BOTANICAL NOTES FROM KNOB LAKE AREA IN THE INTERIOR OF LABRADOR PENINSULA

By Ilmari Hustich

INTRODUCTION

The Knob Lake area (See Figures 4 and 5) was visited by the author in 1948 from August 8 to September 4. For the generosity shown by the General Manager of the Labrador Mining and Exploration Company, Mr. W. H. Durrell, in allowing a foreign forest botanist to visit this interesting part of the unknown interior of the Labrador Peninsula, I here express my sincere gratitude.

The author's studies in 1948 were supported by the National Museum of Canada jointly with the Arctic Institute of North America. This was made possible by the kindness of the Chief Botanist, Mr. A. E. Porsild, Ottawa, and the Director of the Arctic Institute, Dr. A. L. Washburn, Montreal.

The staff at the mining base camp at Burnt Creek helped the author in many ways, as did also the pilot of the Norseman plane at Knob Lake, Mr. Henry Gates.

The plants collected during the summer have been deposited in the National Herbarium of Canada, Ottawa; a duplicate set was given to the Botanical Institute of the University in Helsingfors. My paper on the Forest Geography of the Labrador Peninsula (Acta Geographica No. 10, 2, 1949) may serve as a background for this paper.

GEOGRAPHICAL FEATURES OF KNOB LAKE AREA

The Knob Lake area lies on the northern border of the central watershed region in the interior of the Labrador (Ungava) Peninsula (See Figure 4). The average altitude is approximately 2,000 feet above sea-level. The highest mountain massif in the area, Irony Mountain, about 3,000 feet, is probably the highest mountain in the Labrador interior. The area is topographically marked by its rolling mountain ridges and sand and gravel eskers, trending for the most part in a northwest-southeast direction. Between the eskers and ridges there are narrow lakes and bogs. The topography is dominated by the structural trends of the Precambrian sediments.

The Precambrian sedimentary bedrock (See Low 1896 and Tanner 1944) in the interior of the Peninsula is of great phytogeographical importance. The flora in this area seems to be richer and the tree growth more luxuriant than in the surrounding granite and gneiss area. The sedimentary bedrock is composed of iron formation, shales, slates, breccias, quartzites, and dolomites lying on granite.

During the Pleistocene epoch, ice overrode the area leaving glacial till of heterogeneous composition. The sand and gravel ridges, which are a common feature in the area, were produced by the melting ice. Terraces about 60 feet high are of frequent occurrence around lakes. From the air, the sand plains and terraces are easily distinguished by their characteristic cover of spruce lichen forest.

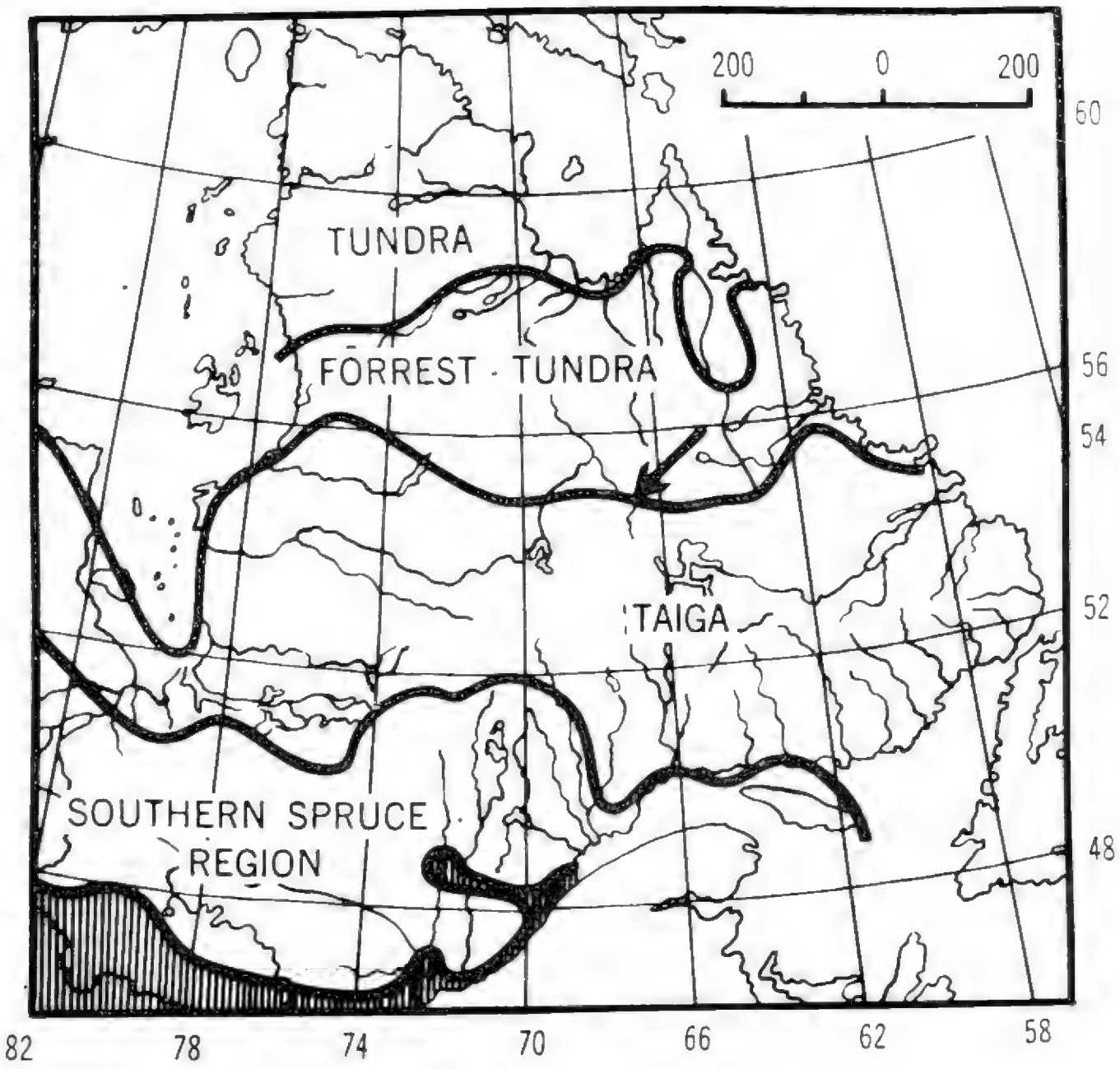


Figure 4. The main forest regions on the Labrador Peninsula. The arrow shows the Knob Lake area.

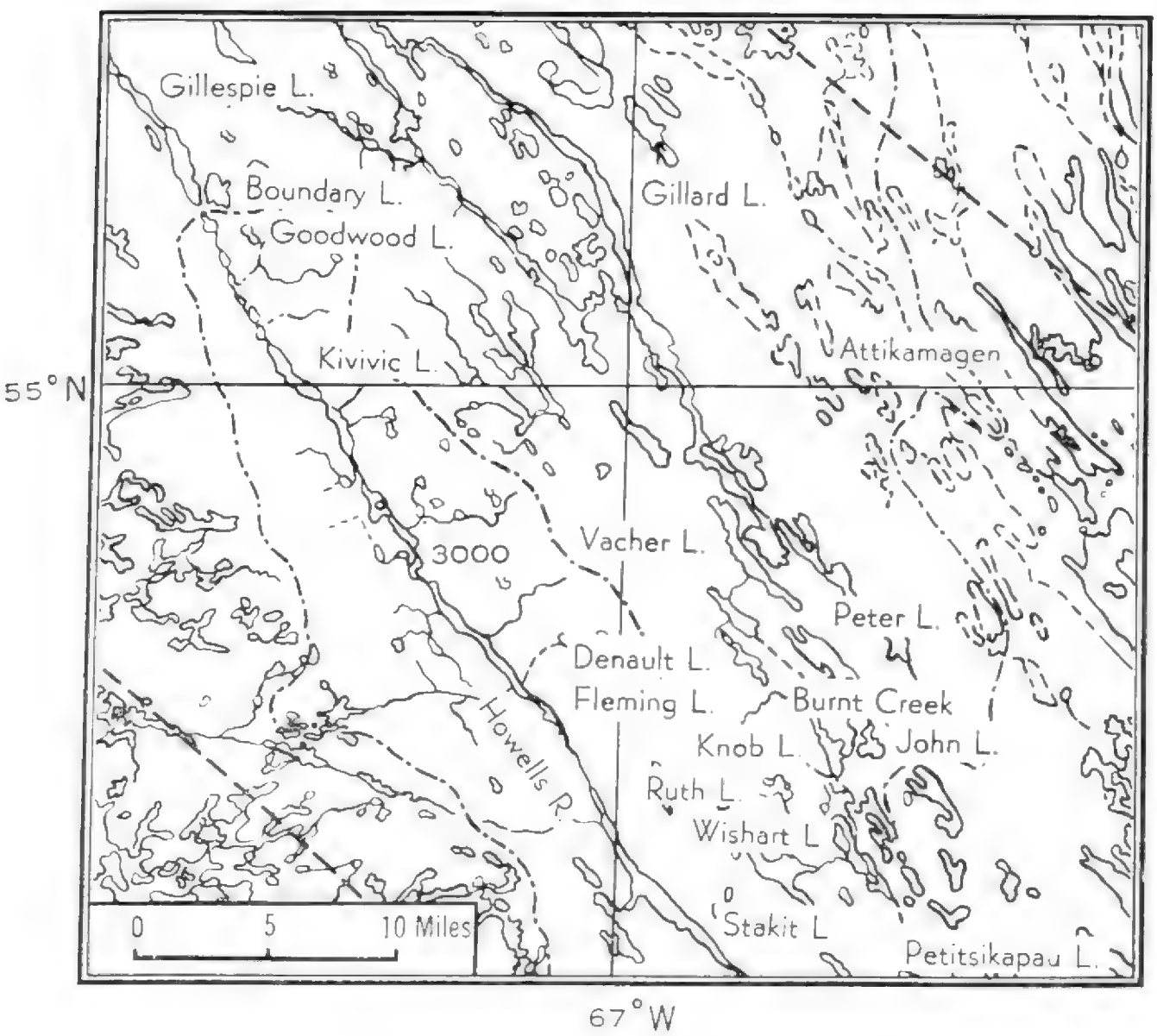


Figure 5. The Knob Lake area (after the Dyke Lake sheet of the National Topographic series, Aeronautical edition, 1947); the names Burnt Creek and Goodwood are added to the map.

The climate of the interior is still largely unknown, although some general information is given by Connor 1938, Tanner 1944, and Villeneuve 1946 and 1948. The summer must be considerably warmer than in the coastal areas with the exception of the mountain areas, where in a few places one could see snow patches at the beginning of August on the Goodwood mountain plateaux; these snow patches melted in 1948 late in August. The winter snow cover in the lowland of the area is generally 5 to 6 feet deep, judging from the spruce trees and from the height of the ground birch scrub. No specific observations were made of permafrost; however, the sudden lowering of the water level in the small ponds late in August was probably due to the late melting of the ground ice in the bottoms of the ponds.

The general topography is illustrated by Plates XXXII to XLIV.

GENERAL REMARKS ON THE FLORA AND VEGETATION

The Knob Lake area is situated between the taiga proper and the forest-tundra (See Figures 4 and 5) (Compare Hustich, 1949). The varying topography causes great variations in the vegetation, which ranges from astonishingly luxuriant fens, white spruce, and balsam poplar groves to dry alpine heaths on the higher mountains. The area investigated shows great resemblance to some mountain areas of Swedish and Finnish Lapland.

The forest vegetation is described in considerable detail on pp. 182 to 193.

PLATE XXXII

Mountain plateaux near Irony Mountain. September, 1948.

Low-lying wet areas of the Knob Lake district generally have the richer flora, including typical fens, rich in grasses and herbs, mostly with scattered tamaracks. Bogs, less rich in species, may also be seen in the area; the author, however, did not see large bogs of the type that seem to dominate the granite-gneiss area outside the Precambrian bedrock area. South of this Knob Lake area the wide bogs of the so-called "aapa" type (See Wenner 1948) occur. No "palsa" bogs of the kind described by Wenner 1948 and Hustich 1939 from the Labrador coast were seen in Knob Lake area.

PLATE XXXIII

Tree-line near Burnt Creek, white spruce, altitude 2,000 feet. August, 1948.

The lakes are mostly clear and cold and inhabited by an aquatic flora poor in species. The small ponds in the "alpine" areas show, as pointed out above, a marked variation in the height of their water level, thus strongly affecting the flora and vegetation on their shores and producing specific habitats. Some notes on the aquatic flora appear in chapter 4.

As mentioned by the author earlier (1939), the vertical zonation of the tree-line in Labrador differs from that of the Scandinavian mountain areas. No real counterpart to the typical Scandinavian mountain birch (*Betula tortuosa* Ledeb.) region, the so-called subalpine region, can be seen. The spruce forest on higher altitudes becomes successively more "open", and the trees are low with rugged and branched stems. Ecologically, a subalpine belt may be distinguished on these mountains; I refer to the remarkable

"semitundra" formation on the mountain plateaux around Irony Mountain. Here, low spruce scrub, generally of black spruce, appears scattered on a vegetation of more or less tundra character. The height of this black spruce scrub seems to be limited to the height of the snow cover (See p. 175) and Plate XXXVI. The alder belt, so characteristic of the coastal mountains of Labrador, is not well developed in the interior; however, on mountains facing Howells River valley, dense alder scrub occurs on the slopes above the spruce forest proper.

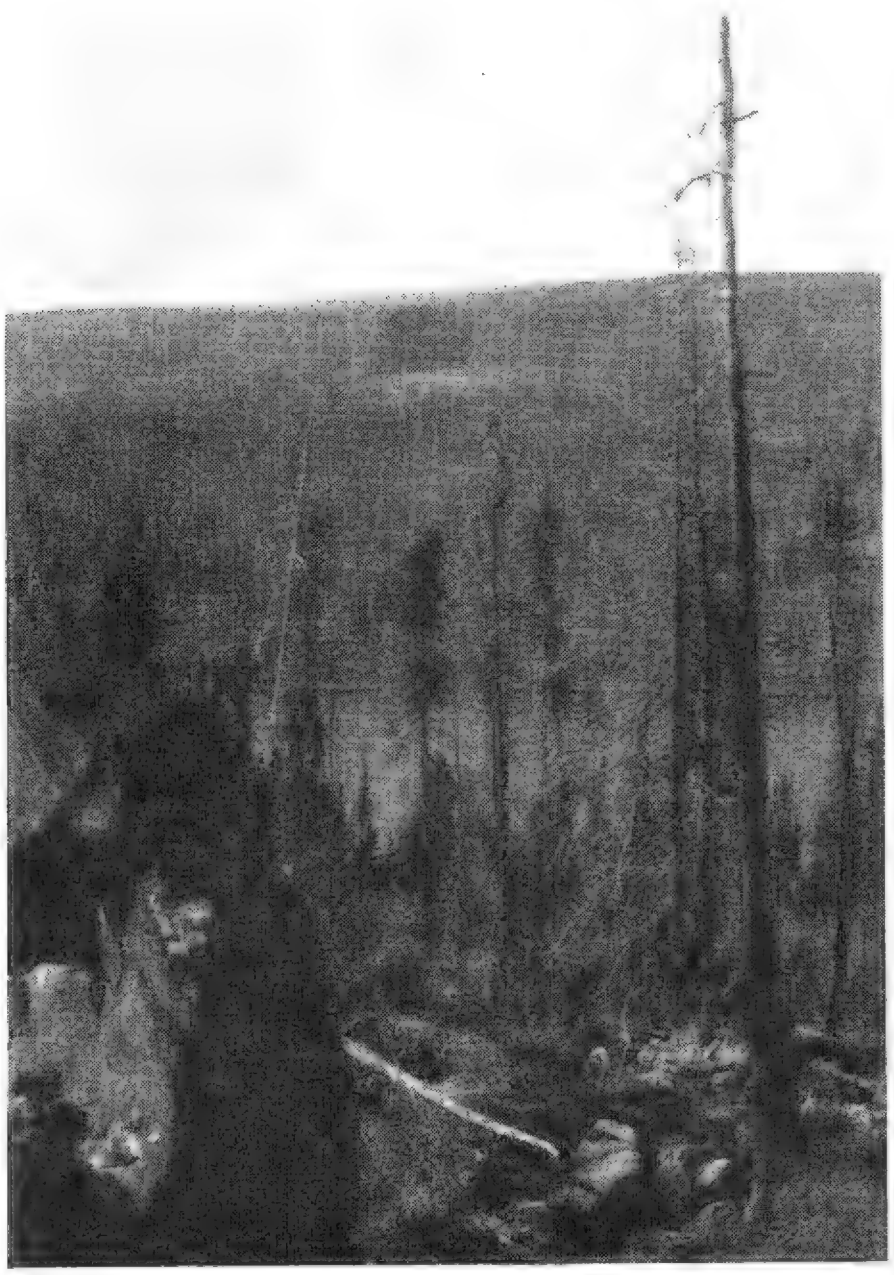
PLATE XXXIV

Low mountain near Lake Gillard, view northwards; note the "polygon" formation in the foreground. August, 1948.

An alpine flora and vegetation occurs on the mountain ridges and crests. It is generally very poor in species, except where dolomite boulders occur, scattered on the crests or in small depressions on the mountains with glacial till of dolomite or shale origin. Some notes on the alpine element in the flora appear on p. 199. The tree-line reaches nearly to the top of Irony Mountain, i.e. about 3,000 feet, although the forest limit proper reaches only to 2,500 feet.

The interior of Labrador is floristically very little known. Macoun made the first studies of the Labrador flora in 1895. He listed 147 species from Hamilton River area, which includes the whole eastern part of the interior of Labrador. The list at the end of this paper, from a very small area only, contains 253 species and varieties, and is probably the first nearly complete list of plants from any part of the interior. On the Labrador

PLATE XXXV



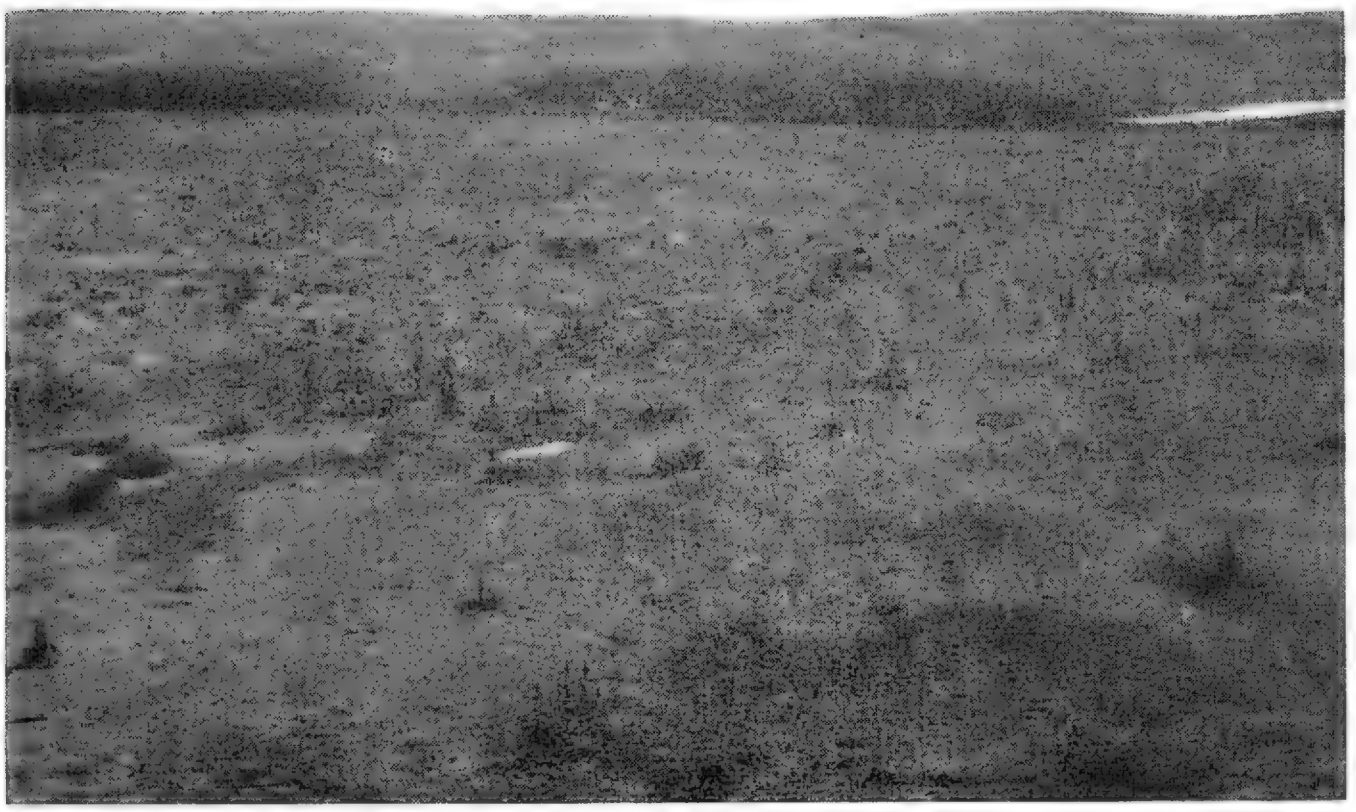
Dolomite cliffs near Ruths Lake; in the background, as partly in the foreground, burned forest. August, 1948.

coast a richer flora occurs, due to the many different habitats available, including skerries, salt marshes, etc. My collection from the Labrador coast (1937) contained about 380 species. The arctic flora of the Labrador Peninsula comprises 172 species (Polunin 1940). If we take into account the lack of thorough investigation, the flora of the Labrador interior must still be considered very poor in species. The Knob Lake area is probably fairly typical for the Precambrian bedrock belt, which in itself must be

richer in species than the surrounding granite and gneiss area. The general poorness of the flora in the interior of Labrador must at least partly be due to the late retreat of the inland ice. A case in point is the total absence of *Leguminosae*, although climatically the Knob Lake area should be suitable for species of *Astragalus*, *Oxytropis*, *Lathyrus*, and other genera. This statement needs, however, further confirmation from phytogeographers who have investigated other parts of the interior of the Peninsula.

Some phytogeographical notes from the area between the watershed and the Atlantic coast are given by Kindle 1924, Porsild 1944, and Hustich-Pettersson 1943. For the flora in the southwestern interior of Labrador,

PLATE XXXVI



Open tundra on the slopes of Irony Mountain. The low shrubs are black spruce, the trees white spruce. September, 1948.

see Dutilly's collections and Macoun's list of 1895. The flora of the Mistassini area will be described by Rousseau in the near future, and Abbe is preparing a paper on his careful floristic investigation of the Richmond Gulf area (See Marr 1948). Until these papers appear, the flora of Knob Lake area cannot be compared properly with other regions in the interior.

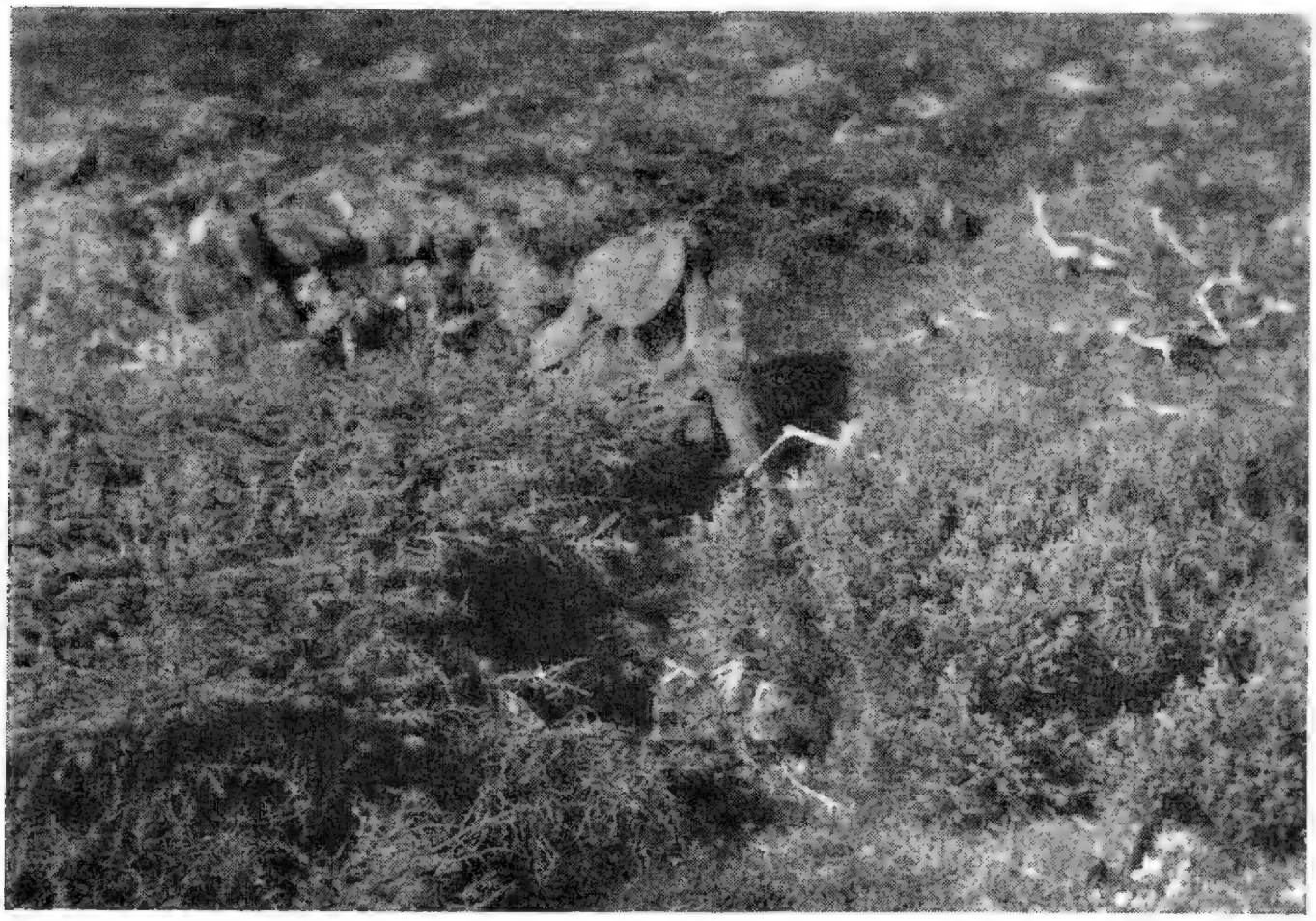
The writer found no "anthropochore" plant in Knob Lake area in 1948, the reason being that the base camp for mining exploration work was supplied entirely by air (Compare Porsild, 1945). In Ashuanipi, 200 miles south of Knob Lake, one "anthropochore" plant was found, i.e. *Potentilla norvegica*, which may have been brought by the Indians from Seven Islands on their autumn migration inland.

FORESTS

The forests in the area are composed of the following species: white spruce, *Picea glauca*; black spruce, *P. mariana*; balsam fir, *Abies balsamea*; tamarack, *Larix laricina*; paper birch, *Betula papyrifera*; and balsam poplar, *Populus tacamahacca*. The area lies outside the northern limits of Banksian pine, aspen, and, of course, cedar (See the tree-line maps in Hustich 1949). Only white spruce, black spruce, and tamarack are of importance. The typical taiga forest of the lowland parts of the Knob Lake area is composed of these three species.

The spruces. Black spruce and white spruce are both common in the area. White spruce usually grows more luxuriantly and in richer habitats. White spruce is also remarkably common in poorer habitats, often forming white spruce lichen heaths or occurring intermingled with black spruce on stony lichen heaths. White spruce attains a height of about 60 feet and a diameter of 30 inches. Black spruce grows to about 48 feet high and 20 inches in diameter at the most. The difference in ecology between the two species is not easy to establish (See Plate XXXVII). On pure iron formation habitats there seemed to be little white spruce, and on typical dolomite or shale habitats black spruce was usually scarce. Under extreme conditions prevailing at the tree-line, however, an ecological difference between the two species becomes quite evident. Plate XXXVI shows

PLATE XXXVII



Near timberline stunted white spruce (left) and black spruce (right) often look alike. Irony Mountain. September, 1948.

the "semitundra" near Irony Mountain. The scrub is black spruce; the rugged small trees are white spruce. Thus, the prevailing idea that the white spruce is a less hardy species than black spruce is untenable, at least in this area. The same difference between the two species was seen at the maritime tree-line in Hudson Bay (notes from 1947), where white spruce formed the coniferous tree-line on the outermost islands reaching tree-size where black spruce occurred as stunted bushes, only reaching the height of the snow cover.

The difference in habit between the two spruce species in the Knob Lake area was noted in the field as follows:

White spruce reaches greater size and does not usually form so-called candelabrum trees or adventitious roots. The branches are horizontal. The glaucous twigs are clear green, the bark light green and fairly smooth, the needles about 8 to 10 mm. long, the cones at the top of the uppermost twigs about 3 to 4 cm. long.

Black spruce often forms so-called candelabrum trees, i.e. distinguished by having several stems from the same root (See Plate XXXIX), and adventitious roots. In these the branches are usually turned a little upward, the hairy twigs are mostly a little darker, the bark is rough, the needles 6 to 8 mm. long, and the cones, 1·5 to 2 cm. long, are clustered at the top of the tree. Cone production of both spruce species seems to be

PLATE XXXVIII

Charred stumps and fallen trunks on the bottom of this alpine pond show that this area near Burnt Creek was once forested. August, 1948.

ample, but the case may be different in the production of mature seed. Information about reproduction is given on page 196. As to the quantity of seedlings, no real difference between the spruce species could be established in so short a time.

The common black spruce forest type, the muskeg, is not very common in this area, because the type of bedrock favours the development of rich damp forests.

PLATE XXXIX

Black spruce-lichen forest burned in 1947; note the candelabra-shaped trees. Burnt Creek area. August, 1948.

Tamarack. Compared to other areas in Labrador that the author has visited, the Knob Lake area seems to be richer in tamarack. The impression is probably due to the abundance of fens and swamps, habitats where scattered tamaracks always occur. The species is also common on drier habitats in this area where tamarack-dominated lichen heaths were often seen.

Tamarack, in the area, attains a height of about 35 feet and a diameter of 10 to 12 inches. Cone and also seed production seemed to be satisfactory, as shown by the relatively large number of seedlings which were noted in many habitats, particularly in swamps. Where the spruce and tamarack grow together, the reproduction of the latter appeared to be somewhat better than that of the spruce. For age determination of the seedling see Table II.

PLATE XL

Recently burned white spruce forest near Burnt Creek, August, 1948. Note the striking difference in the shape of the trees shown in Plates XXXIX and XL.

Balsam fir. This tree occurs only here and there in the area but often forms dense thickets along brooks and, besides, occurs in well-drained depressions in white spruce forests, etc. I found only three balsam fir seedlings, whereas vegetative propagation by rooting branches was very common, and still more common in the case of black spruce. Balsam fir was found in several places near Lake Gillard (Plate XXXIV), on the small

lake northeast from Lake Gillard, at Burnt Creek, Knob Lake, and Ruth Lake. The staff at Burnt Creek told me that balsam fir also occurs at Eclipse, 90 miles to the northwest.

Balsam fir does not attain great size in this area. The largest fir noted was about 40 feet in height and 8 inches in diameter. When the four coniferous species occur together, porcupines prefer balsam fir, black spruce, tamarack, and white spruce, in the order mentioned.

PLATE XLI

White spruce-lichen forest on terrace near Lake Gillard. Note seedling and the "snow line" on the tree. August, 1948.

Paper birch. Paper birch of considerable size (the largest 24 feet in height and 19 inches in diameter) was found only on the northern slope of the mountain west of Lake Denault. These trees probably belong to the variety *Betula papyrifera* var. *cordifolia.* Birch of smaller size was found east of Ruth Lake and on some slopes between Burnt Creek and Ruth Lake

Shrub-like birches, not of the *Betula papyrifera* complex, were found in several localities near Burnt Creek (See p. 193). The fact is worth mentioning that the birches occurred most frequently on slopes but never formed anything comparable to the Scandinavian mountain birch belt. Dr. Fleming, a geologist, told me that rich paper birch groves occur at Kaniapiskau River northwest of Burnt Creek.

PLATE XLII

Old white spruce forest; dense ground cover of *Betula glandulosa*. Near Burnt Creek, August, 1948.

Balsam poplar. This tree was seen only twice. The best locality was pointed out by a worker at the base camp and lies at the northwest end of John Lake (See p. 192). A prominent feature of this balsam grove was the luxuriance of its associated vegetation. Propagation was vegetative only, and no reproduction by seed was observed. A smaller balsam poplar grove was later seen at the southeast end of John Lake. The largest balsam poplar seen was 21 feet in height and 6 inches in diameter. Dr. A. Retty, a geologist, told me that balsam poplar grows on an island in Dyke Lake.

The forest shrubs. The tree-like birch species have been discussed above. Other species collected on the subalpine slopes are mostly *Betula minor* and *B. borealis* (See p. 200) but are of no importance from a forest-botanical point of view.

The common and ubiquitous dwarf species here, as in other parts of Labrador, is *Betula glandulosa* which usually attains the height of the winter snow-cover only, except in localities where it is associated with alder.

PLATE XLIII

Note the "snow line" on this snow-damaged black spruce group, near tree-line on mountain near Burnt Creek. August, 1948.

Betula pumila was also found (See p. 209), and the rare *Betula Michauxii*, which is closely related to the European *Betula nana*, was seen but once.

Mountain alder, *Alnus crispa*, is common along lakes and rivers, on mountain slopes, and in wet depressions in spruce forest, whereas speckled alder, *A. rugosa* var. *americana*, was not found in Knob Lake area but occurs in the granite-gneiss area at Ashuanipi, 200 miles south of Knob

Lake. It was seen at Great Whale River in 1947 but is probably absent in the Precambrian sedimentary belt of the interior. The mountain alder grows 15 feet high and 2 to 3 inches in diameter at the most. Spruce trees growing together with alder are usually of good size.

Mountain ash, *Sorbus decora* var. *groenlandica*, is rare in this area. It was seen at Knob Lake as a sterile shrub 12 feet high in a subalpine valley with rich glacial till.

PLATE XLIV

Mountain brook near Burnt Creek. Centre foreground, *Heracleum lanatum*, *Arabis alpina*, and *Salix glauca*. *Urtica gracilis* also grew here. August, 1948.

Juniper, *Juniperus communis* var. *depressa*, occurs sporadically in the area; it prefers sunny cliffs on the mountain slopes but is found also in spruce forest on flat dolomite rocks and, occasionally, as a component of spruce-lichen heaths.

Among the willows, only *Salix Bebbiana* reaches tree size. The difficulty of determining willows in the field makes the notes on their distribution in the forest uncertain, and one must depend only on the collected

material. However, *Salix planifolia* and *S. pedicellaris* seem to be the common forest willow species in this area as elsewhere in the Labrador taiga. For the distribution of the genus *Salix* in Labrador, see Raup 1943.

Other forest shrubs occurring in the area are: *Ribes glandulosum, R. triste, Amelanchier Bartramiana, Cornus stolonifera,* and *Viburnum edule.*

NOTES ON THE FOREST VEGETATION

In the following analyses of forest habitats, which are based on twenty-six sample plots, size and frequency notes are visual estimates. The size of each sample plot is about 4 square metres. The frequency of the vascular plant species on the plots is indicated by the following simple scale: 3 means abundant ("dominant"), 2 means common, 1 means scattered, and the symbol "+" means occasional (one or two individuals only). This simple method has been used by the author in his previous field work and is probably adequate for a preliminary survey. Notes on the approximate size of the trees on an area of about 100 square metres (about one-fortieth acre) around the sample plot are added to give an idea of the forest type. Regeneration in the sample plots was carefully noted. In most cases seedlings were collected for microscopical age determination. Radial growth will be analysed in another paper, comprising tree-ring-growth measurement from other areas in Labrador as well. Cryptogams were collected on the sample plots. The rather incomplete notes on lichens are based on the author's field notes, whereas the mosses have been determined by the well-known bryologist, Dr. Risto Tuomikoski. The determination of the common plants of the "taiga" in Table I was made by the author in the field; the rare and critical species were determined by A. E. Porsild, Chief Botanist of the National Museum of Canada (See the catalogue). For the assistance in determining the plants I here express my deep gratitude.

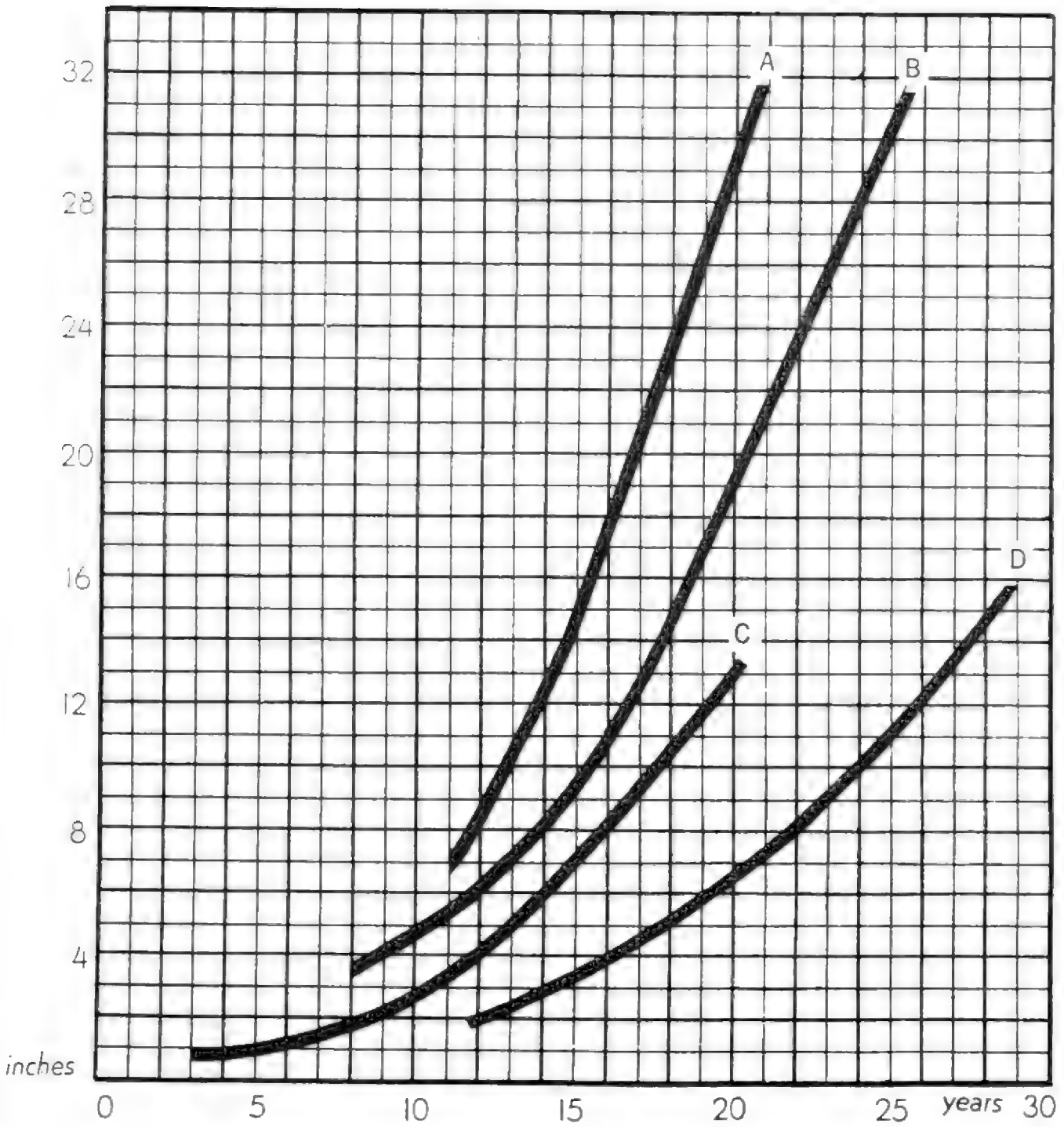
The vegetation of the sample plot is noted in Table I for the localities, 1-22, below. The height of trees is given in feet, the diameter in inches; thus the expression 21 by 6 means a tree 21 feet in height and 6 inches in diameter at breast height (DBH).

1. Lake Gillard. A small rocky point, about 30 feet above the lake level; the bedrock is iron formation. The sample plot is on a nearly flat, rocky plain partly covered with gravel; the dominant tree is black spruce of the "candelabrum habit". Vegetation, see Table I, 1. Trees on about 1/20 acre: 1 candelabrum black spruce with seven stems measuring 27, 21, 15, 12, 7, 4, and 3 feet high, respectively; 7 black spruce trees about 9 to 21 by 3 to 6; 1 white spruce 3 by 1.

Reproduction: 12 seedlings on 1/20 acre; 10 black spruce (8 to 20 years old); 2 white spruce (12 to 21 years). See Diagrams 1 and 3.

Cryptogams: *Cladina alpestris* dominates, forming a 4- to 5-inch-thick cover. Scattered mosses: *Pleurozium Schreberi, Dicranum majus, D. fuscescens, Barbilophozia Hatcheri.*

2. Lake Gillard, on the same point and habitat as sample plot No. 1. Black and white spruce equally dominant in the vicinity, but on this sample plot itself only white spruces.



Diágram 1. Growth in height and age of black spruce seedlings from the Knob Lake area. A=locality No. 26 (See the text), B=locality No. 21, C=locality No. 1, D=locality No. 20. *Note the slow growth,* compare with Diagrams 2-4.

On 1/20 acre, white spruce, 24 by 7, 24 by 6, 39 by 14, 18 by 5, 15 by 4, 15 by 3, 12 by 2; and a dead tamarack, 12 by 4. No reproduction because there are no openings in the thick lichen cover which consisted chiefly of *Cladina alpestris* with scattered *Dicranum* cfr. *fuscescens*.

3. Two miles north of Burnt Creek, in the upper part of the forest belt, on stony iron formation. Mountain slope with southern exposure and dominating white spruce. Near this sample plot grew a beautifully developed 11-stemmed candelabrum black spruce.

Trees growing on 1/40 acre: white spruce, 30 by 10, 33 by 9, 24 by 6, 27 by 7, 15 by 3, 24 by 4, 6 by 2, 24 by 5, 15 by 5, 18 by 5; black spruce, 24 by 6, 12 by 2, 12 by 2, and 6 by 1. A few cones were noted on the black spruce, none on the white spruce.

Reproduction: one white spruce seedling, about 55 years old and about $1\frac{1}{2}$ feet high.

Cryptogams: *Cladina alpestris*, dominant with patches of *C. rangiferina*, *Pleurozium Schreberi*, and *Dicranum* ssp.

4. West of Lake Wishart, southwest from the base camp at Burnt Creek, about 300 feet above the lake, on iron formation. Snow-damaged and stunted white spruce, covered with thick, black *Alectoria*. No black spruce. On the 1/40 acre plot grew the following white spruce: 30 by 8, 27 by 11; 24 by 8, 15 by 5, 12 by 4, 15 by 4, 7 by 4, 6 by 4, 6 by 3, 6 by 3, 6 by 3. Poor reproduction, because of the thick lichen cover, 4 white spruce seedlings (age 22 to 40 years, height 5 to 7 inches) only.

Cryptogams: *Cladina alpestris* forming a 5- to 6-inch-thick carpet with occasional *C. rangiferina* and *C. mitis*, *Cetraria islandica*, and scattered mosses: *Dicranum fuscescens*, *Polytrichum* spp. and *Ptilidium ciliare*.

5. Southwest of Knob Lake. Black spruce–lichen scrub forest (on iron formation?) about 100 feet above the lake level; the sample plot is typical of a large area in the surrounding country. On the 1/40 acre plot about 30 small black spruce trees averaged 15 by 2 to 3, the largest 24 by 5. The trees were about 150 years old, with masses of *Alectoria* covering the very short-branched tree crowns. Very poor reproduction: 2 black spruce seedlings each about 55 years old and $1\frac{1}{2}$ feet high. No vegetative propagation.

Cryptogams: *Cladina alpestris* predominant with *C. rangiferina* and *C. mitis*, *Cetraria islandica*, *Nephroma* sp., and scattered mosses: *Pleurozium Schreberi* and *Dicranum fuscescens*.

6. One mile north of Burnt Creek, fairly pure tamarack-lichen forest on the flat bottom of a mountain valley, on iron formation. Scattered white spruce (black spruce candelabrum trees in the neighbourhood). Trees on about 1/40 acre: tamaracks, 27 by 6, 24 by 4, 24 by 10, 24 by 4, 18 by 4; white spruce shrubs, 6 by 3, 3 by 2, 3 by 1. The tamaracks show rich cone production.

Reproduction: Three tamarack seedlings were 12 to 35 years old, and four were about 4 years old, and one white spruce seedling, about 48 years old, was 1 foot high.

Cryptogams: dominant *Cladina alpestris* cover. (*Orthocaulis gracilis* collected here.)

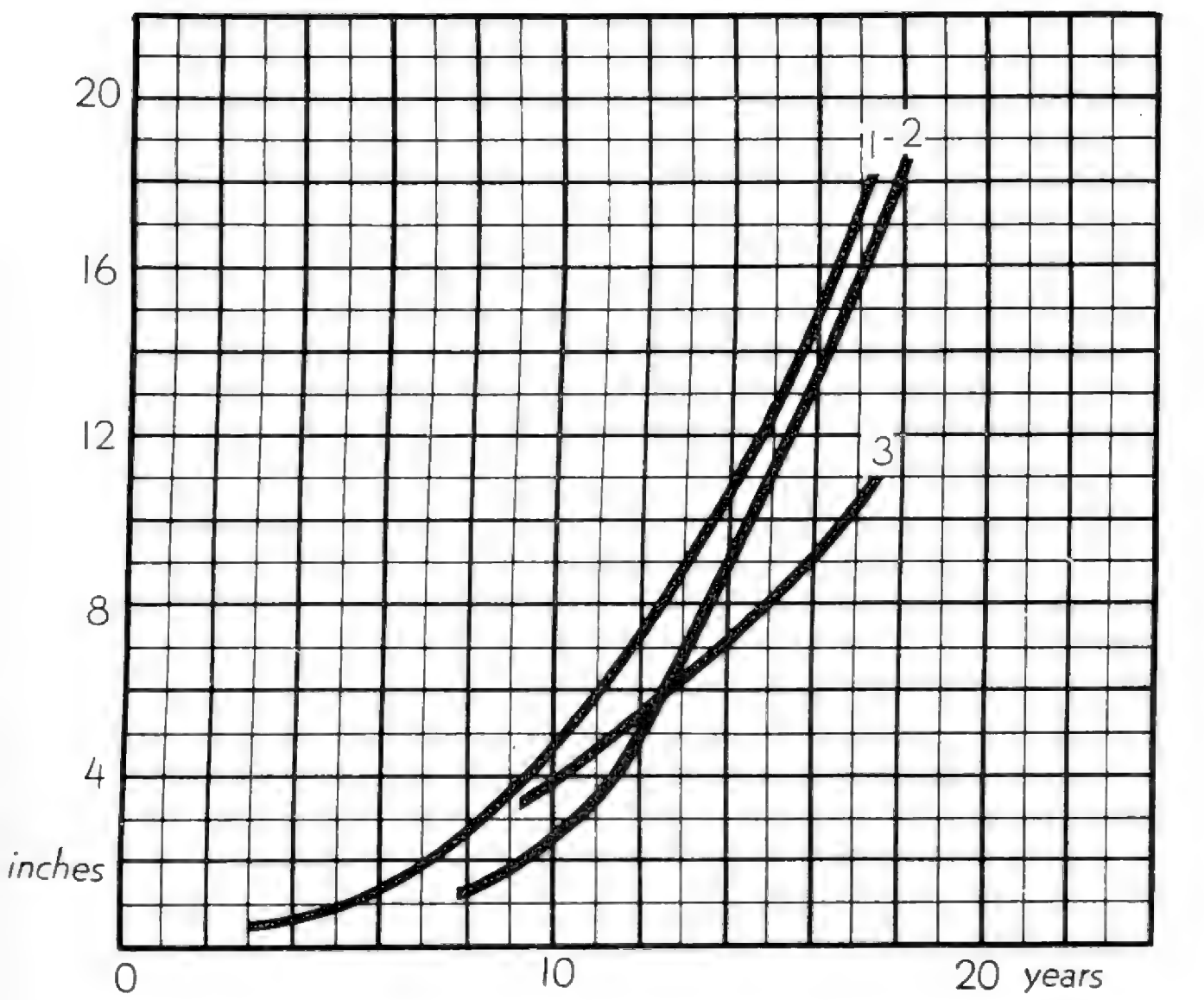


Diagram 2. Growth in height and age of white spruce seedlings from the Knob Lake area. 1=from locality No. 7 (See the text), 2=locality No. 25, 3=locality No. 26. *Note the slow growth.*

7. Lake Gillard. A stony, flat area on iron formation, near sample plot No. 1, on a point in the lake. Spruce lichen forest. Trees on about 1/20 acre: 1 candelabrum black spruce with six stems, 36, 18, 15, 12, 9, and 9 feet high respectively, the main trunk 8·5 inches in diameter; 3 black spruces, 27 by 5, 18 by 4, and 15 by 4; 5 white spruces, 27 by 7, 15, 5, 7 by 2; 1 tamarack, 13 by 2.

Reproduction good because of numerous openings in the lichen cover: 25 white spruce seedlings from 3 to 40 years old, see Diagram 2, 19 black spruce seedlings from 8 to 27 years old, and 1, 12 year old tamarack seedling. The distribution of seedlings on the sample plot is uneven as usual. On one open patch in the lichen cover, about 4 metres square, 30 seedlings were collected.

Cryptogams: *Cladina alpestris* forming a 6- to 7-inch-thick cover; on the open patches, *Polytrichum juniperum* and *P. piliferum.*

8. One mile northwest of Burnt Creek. A sample plot in a dwarf white spruce–lichen forest. Scattered stunted white spruce trees. Snow cover approximately 6 feet. Tree crowns covered with *Alectoria.* No cones in 1948, but a fair cone production in 1947 (i.e. cones of flowering year 1946). On 1/40 acre the following white spruce: 27 by 10, 33 by 9, 30 by 9, 36 by 10, 36 by 11, 27 by 7, 27 by 9, and one nearly dead tree, 27 by 8.

No reproduction owing to the dense *Betula glandulosa* scrub on the sample plot.

Cryptogams: half of the sample plot covered with *Cladina alpestris,* incl. *C. rangiferina, Cladonia* ssp. and *Peltigera* sp., the other half with thick *Pleurozium Schreberi* and *Dicranum fuscescens.*

9. Northwest of John Lake. A gentle slope about 150 feet above the lake level, protected from the large fire of 15 to 20 years ago. Good black spruce pulpwood forest (feather moss type) on iron formation. White spruce in the neighbourhood.

On about 1/40 acre the following black spruce were measured: 36 by 12, 39 by 10, 30 by 8, 36 by 7, 36 by 7, 36 by 6, 33 by 6, 33 by 6, 30 by 5, 15 by 2 18 by 4, 9 by 2. Reproduction poor because of the thick moss cover: 1 black spruce seedling, 25 years old, 15 inches high, and only a few vegetative shoots.

Cryptogams: dominant *Pleurozium Schreberi,* incl. *Ptilidium crista castrensis* and *Dicranum* ssp., and scattered *Cladina rangiferina, C. mitis,* and *C. alpestris.*

10. Lake Gillard. A fairly dry spruce–feather moss forest, about 30 feet above the lake level on the east shore of the lake. Good, but not dense, stand of black and white spruce of uneven age.

Trees on about 1/20 acre: white spruce, 48 by 11, 48 by 9, 45 by 8, 45 by 8, 45 by 8, 30 by 7, 30 by 5, 24 by 4, 24 by 4, 21 by 4, 18 by 2, 15 by 2; black spruce, 42 by 10, 42 by 9, 45 by 8, 12 by 3, 9 by 1.

Reproduction poor because of the thick moss cover: 5 old white spruce seedlings, 35, 44, 47, 55, and 60 years of age measuring $1\frac{1}{2}$, 2, $1\frac{3}{4}$, 2, and $1\frac{1}{2}$ feet, respectively; 1 tamarack seedling (nearest tamarack tree about 120 feet from the sample plot); only one black spruce showed vegetative propagation.

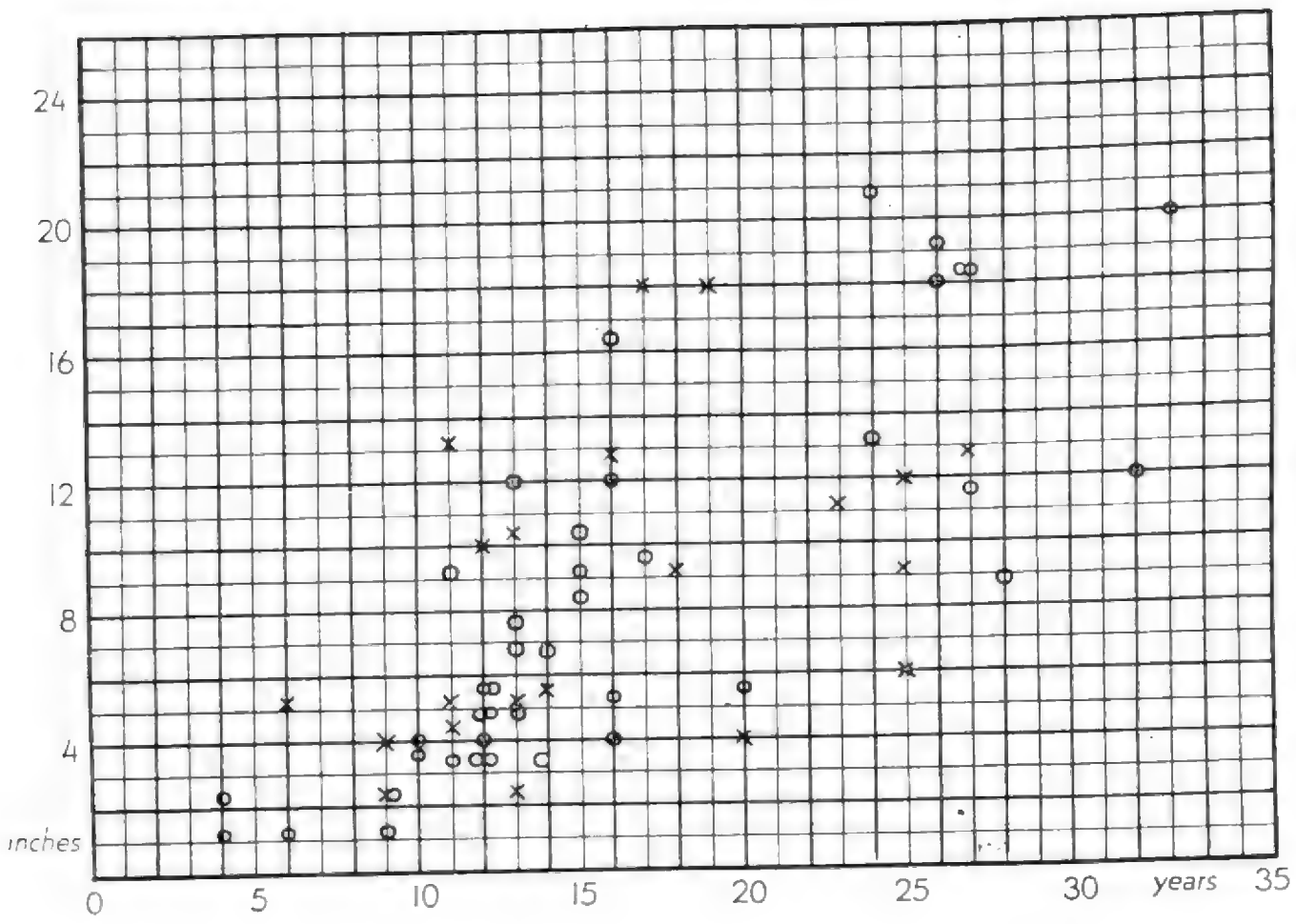


Diagram 3. Growth in height and age of white and black spruce seedlings from the Knob Lake area (from a spruce lichen forest near sample plots 1 and 2, see the text). o = white spruce seedlings, x = black spruce seedlings. Note that no difference in the earlier development of the two species can be found.

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CRYPTOGAMS: dominant *Pleurozium Schreberi*, with *Ptilium crista castrensis, Dicranum fuscescens, Ptilidium ciliare, Barbilophozia Hatcheri*, and *Opisteria arctica*.

11. Lake Gillard. In a small valley near the east shore of the lake, about 15 feet above the lake level. White spruce–bunchberry forest of pulpwood size.

Trees on about 1/20 acre: white spruce, 36 by 7, 33 by 6, 30 by 7, 33 by 8, 33 by 8, 30 by 6, 30 by 5, 27 by 8, 27 by 6, 25 by 5, 21 by 4, 21 by 4, 21 by 4, 9 by 2; one black spruce candelabrum tree with five stems measuring 27 by 8, 28 by 7, 27 by 6, 9 by 2, 9 by 2. Reproduction poor, only 2 black spruce seedlings, 63 and 25 years old, both 2 feet high and with well-developed adventitious roots; these seedlings will develop later into candelabrum trees.

CRYPTOGAMS: Mostly *Hylocomium splendens* and *Pleurozium Schreberi*, incl. *Ptilium crista castrensis, Dicranum fuscescens, Polytrichum commune, Aulacomnium palustre, Barbilophozia Hatcheri*, and scattered *Cladina* ssp. and *Nephroma* sp.

12. West slope of Howells River valley between Lake Stakit and the mountains west of Lake Wishart. Mossy mountain forest of tall white spruce, rich in herbs, not devastated by the big fires in these regions 15 to 20 years ago.

Trees on about 1/40 acre: white spruce, 54 by 18, 57 by 12, 51 by 19, 42 by 8; black spruce, 48 by 7, 42 by 9, 36 by 6.

No spruce reproduction because of the dense ground vegetation and only one 14 year old and $\frac{3}{4}$ foot high tamarack seedling (the nearest tamarack grew about 450 feet from the sample plot).

CRYPTOGAMS: dominant *Pleurozium Schreberi, Ptilium crista castrensis*, incl. *Dicranum fuscescens, Polytrichum* ssp. *Peltigera aphthosa*.

13. About 1 mile northwest from Burnt Creek. Gentle slope with dolomite blocks on iron formation; white spruce forest with dense undercover. The white spruce have mostly "double-stems," all of them slightly deformed. The thicket of *Alnus crispa* reaches 9 to 12 and the *Betula glandulosa* scrub 4 to 6 feet high, the winter snow cover being probably 4 to 5 feet deep. One willow (*Salix planifolia*) of almost tree-size, 12 by 1·5.

Trees on about 1/40 acre: white spruce, 33 by 12, 27 by 8, 48 by 14, 30 by 6, 22 by 4, 24 by 9. No cones in 1948.

No reproduction because of the dense ground cover.

CRYPTOGAMS: dominant *Pleurozium Schreberi* and *Ptilium crista castrensis*, incl. *Dicranum fuscescens, Barbilophozia Hatcheri*.

14. About 1 mile west of Burnt Creek. White spruce growing in low-lying wet area along a dry brook between typical spruce-lichen heaths, in the upper part of the forest zone. Glacial till of shale and dolomite origin. Trees on 1/40 acre: white spruce, 48 by 19, 45 by 13, 24 by 5, 6 by 2; black spruce, 27 by 7, and one dead, 27 by 10.

Reproduction poor because of the dense under growth: 1 white spruce seedling 11 years old and 8 inches tall, with adventitious roots, an uncommon feature in white spruce, and only one vegetative shoot of black spruce.

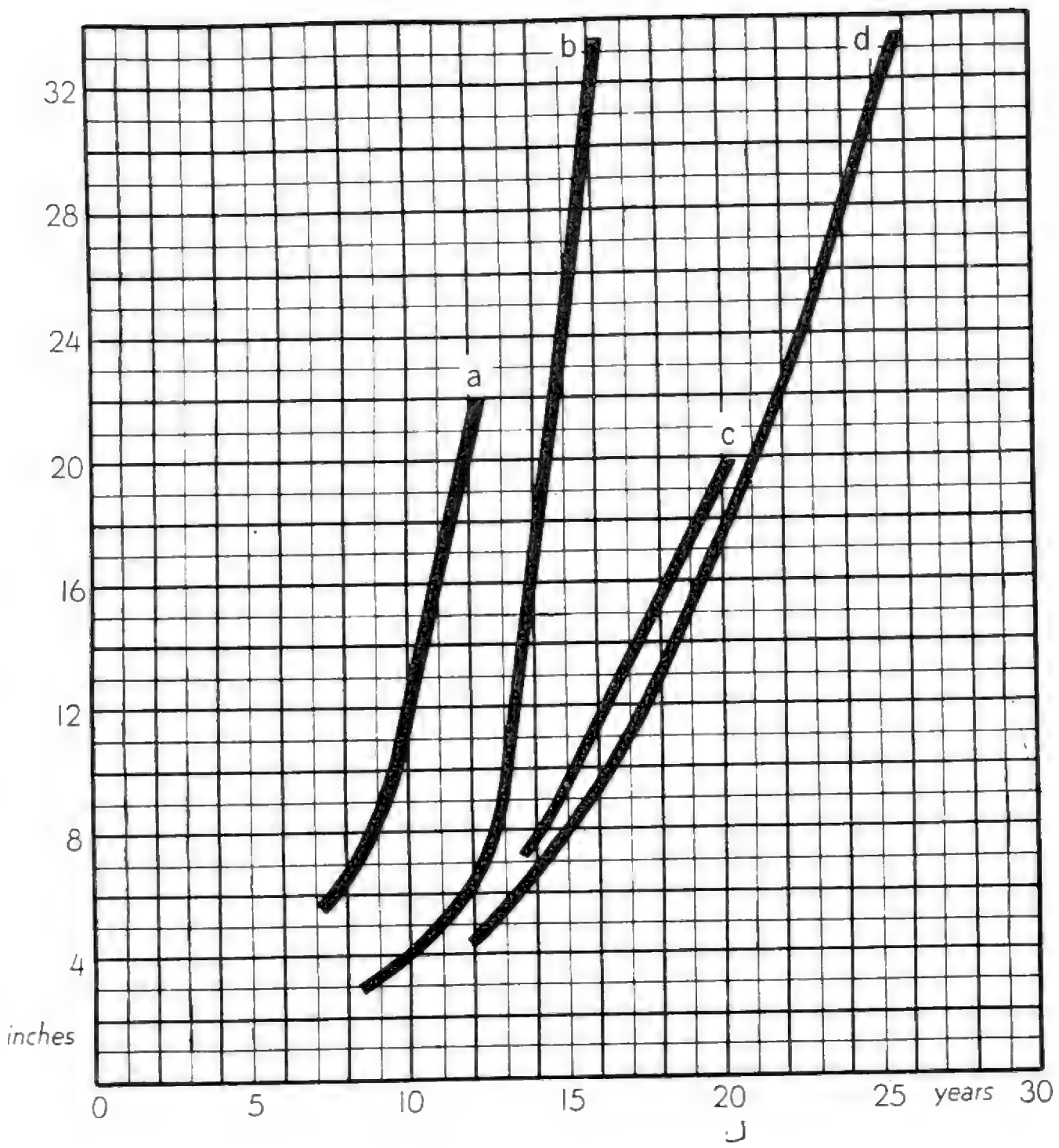

Diagram 4. Growth in height and age of tamarack seedlings from the Knob Lake area, a = locality No. 19, b = locality No. 26, c = locality No. 20, d = locality No. 21, see the text.

Cryptogams: the moss cover rich in species including *Sphagnum Warnstorfianum, Tomenthypnum nitens, Calliergon stramineum, C. sarmentosum, Aulacomnium palustre, Philonotis* sp., *Mnium rugicum, M.* cfr. *pseudopunctatum, Drepanocladus uncinatus, Pleurozium Schreberi, Hylocomium splendens, Ptilium crista castrensis, Dicranum angustum* (!), *Barbilophozia quinquedentata.*

15. Lake Gillard. Patches of white spruce–balsam fir forest, with rich under growth of herbaceous species, along the east shore of the lake, 3 to 6 feet above the lake level. Trees on 1/20 acre: white spruce, 57 by 38 (double stems), 57 by 20, 48 by 14, 45 by 9, 42 by 12, 24 by 4·5; balsam fir, 39 by 8, 24 by 4 (with 5 vegetative shoots), 22 by 5, 21 by 5. 18 by 5; black spruce, 27 by 8. A big white spruce nearby measured 57 by 30.

Reproduction poor: 1 white spruce, 1 black spruce, and 1 balsam fir seedling only (not measured).

Cryptogams: half of the sample plot with *Pleurozium Schreberi* and *Hylocomium splendens*, the rest with *Drepanocladus uncinatus, Sphagnum Russowii, S. Girgensohnii,* and *S. parvifolium.*

16. About 1·5 miles south of the trail between Knob Lake and John Lake, on a gentle southwest-facing slope. A white spruce forest rich in herbaceous species and one of the best forest patches noted in the area. Trees on about 1/40 acre: white spruce, 51 by 28, 48 by 24, 36 by 8, 36 by 6, 30 by 5, 24 by 5, 24 by 4, 15 by 3, 15 by 3; black spruce, 27 by 5, 27 by 5, 15 by 3. On the sample plot were two patches of dense scrub formed by vegetative reproduction; one, formed by black spruce measured 8 by 9 metres; the other, formed by balsam fir measured 12 by 18 metres. A nearby white spruce measured 60 by 24.

Poor reproduction because of the dense ground-cover: 1 black spruce seedling, 24 years old and 1 foot high; 1 balsam fir seedling, 17 to 18 years old and 1 foot high; 2 tamarack seedlings, 12 and 14 years old and 2/3 and 1 foot high, both with adventitious roots.

Cryptogams: Dominant *Pleurozium Schreberi* and *Hylocomium splendens*, incl. *Ptilium crista castrensis, Dicranum angustum* (!), *Pohlia nutans, Barbilophozia Hatcheri, B. barbata.*

17. Snelgrove Lake, 60 to 70 miles southeast from Knob Lake. Rich white spruce forest on the lake shore 6 feet above the lake level, on a very gentle southeast-facing slope.

Trees on about 1/40 acre: white spruce, 57 by 8, 54 by 9, 54 by 8, 54 by 9, 51 by 9, 48 by 8, 42 by 8, 33 by 7, 24 by 4. The trees were about 150 years old and formed a better stand than can be seen on the watershed area proper at Knob Lake. No reproduction because of too dense ground cover.

Cryptogams: dominant *Pleurozium Schreberi,* incl. *Ptilium crista castrensis* and scattered *Cladina rangiferina* and *Nephroma* sp.

18. Lake Gillard. About 300 feet above the lake level. One of the scattered patches of big white spruce in the area, in the valley southeast of the lake. The stand was surrounded by black spruce-lichen heaths.

Trees on 1/20 acre: white spruce, 57 by 22, 54 by 15, 33 by 8; black spruce, 45 by 12, 33 by 12, 30 by 8, 27 by 7, 24 by 7, 24 by 6, 24 by 5.

Reproduction poor: 2 white spruce seedlings, 23 and 44 years old measuring $\frac{2}{3}$ foot and $1\frac{1}{3}$ feet, respectively.

CRYPTOGAMS: dominant *Pleurozium Schreberi, Hylocomium splendens,* incl. *Ptilium crista castrensis, Aulacomnium palustre, Sphagnum Warnstorfianum.*

19. Three miles east from Knob Lake, on shale formation. A rich, low-lying wet area of tamarack between spruce-lichen heaths. The sample plots have a more or less pronounced calciphilous flora, although local areas around decaying tree stumps are acidic and support *Ledum groenlandicum, Vaccinium uliginosum, Equisetum palustre,* and *Oxycoccus microcarpus.* There are several acres of this type of "forest" in the vicinity. Trees on about 1/40 acre: tamarack, 25 by 5, 18 by 3, 15 by 2, 10 by 2, 12 by 2, 9 by 1, 12 by 2, 21 by 4, 21 by 4, 18 by 4, 12 by 2, 9 by 1, 7 by 1, 9 by 1, 3 by 1; the crowns of 50 to 60 per cent of the tamaracks are half-dead. Also ten smaller white spruce, about 4 by 2 in average, the largest 10 by 2 only.

Reproduction good: 36 tamarack seedlings (5 to 13 years old, see Diagram 4), 1 white spruce seedling (13 years old and $\frac{2}{3}$ feet high), and 2 black spruce seedlings about 15 years old.

CRYPTOGAMS: *Sphagnum Warnstorfianum, Aulacomnium palustre, Tomenthypnum nitens, Hylocomium splendens, Paludella squarrosa, Orthocaulis Kunzeanus,* and *Barbilophozia quinquedentata.*

20. Lake Gillard. A wet area about 150 feet above lake level in the valley southeast of the lake. A few acres with scattered balsam fir intermingled with black spruce and tamarack. Among them were numerous decaying old stumps and fallen trees. Here balsam fir shows strong vegetative propagation. Trees on 1/20 acre: balsam fir, 30 by 6, with 4 vegetative shoots (1 foot high), 24 by 5 with 8 vegetative shoots ($\frac{1}{2}$ foot to 2 feet), 24 by 5 with 3 vegetative shoots (1 foot), 24 by 4 with 10 vegetative shoots (1 foot), 21 by 4, 18 by 4 with about 50 vegetative shoots (1 foot), 21 by 4, 15 by 3, 9 by 2; the three last-mentioned balsam firs had produced a total of 20 vegetative shoots about 2 feet high. One balsam fir stump alone had 50 vegetative shoots, On this sample plot there are altogether nine balsam fir trees higher than 9 feet and about 150 vegetative shoots ($\frac{1}{2}$ foot to 3 feet high). Black spruce trees in the sample plot: 39 by 8, 36 by 8, 30 by 6, 30 by 6, 30 by 7, 30 by 6, 24 by 4, 21 by 9, 24 by 4, 18 by 4, 15 by 3, 24 by 4, 9 by 1, 9 by 1, 6 by 1, 6 by 1, 6 by 1; these originate in part from vegetative shoots as can be seen from the bent trunks just on the surface of the ground. Tamarack on the plot: 24 by 4, 21 by 4, 15 by 2.

In addition to the strong vegetative propagation of the balsam fir, reproduction by seedlings occurred on the plot: 18 tamarack seedlings, 13 to 25 years old; 10 black spruce seedlings, 12 to 29 years old, and 2 balsam fir seedlings, 6 to 7 and 10 to 11 years old, respectively. See Diagrams 1 and 4.

CRYPTOGAMS: *Sphagnum parvifolium, S. Girgensohnii, Pleurozium Schreberi, Dicranum fuscescens, Aulacomnium palustre, Drepanocladus fluitans* and scattered lichens, *Cladina mitis* and *C. rangiferina.*

21. Lake Gillard. Near the lake shore and about 75 feet above the lake level. Black spruce and tamarack equally dominant on a wet area several acres wide.

Trees on 1/20 acre: black spruce, 30 by 8, 24 by 6, 24 by 7, 22 by 4, 22 by 4, 13 by 2, 12 by 4, 4 by 1; tamarack, 27 by 6, 24 by 5, 18 by 3, 15 by 6, 15 by 3, 15 by 2; also 5 dead black spruce and 2 dead tamaracks.

Reproduction: 19 black spruce seedlings, 5 to 24 years old; 16 tamarack seedlings, 12 to 26 years old; nearly every one of the 35 seedlings with adventitious roots. See Diagrams 1 and 4.

Cryptogams: dominant Sphagnum-cover of *S. parvifolium, S. robustum, S. nemoreum,* and *S. magellanicum,* incl. *Dicranum fuscescens, Pohlia nutans,* and *Aulacomnium palustre.*

22. One mile east from Knob Lake. Small forest of "sticks" on iron formation (shales in the neighbourhood). Winter snow cover probably $2\frac{1}{2}$ feet deep. Trees on 1/40 acre: black spruce, 18 by 5, 15 by 3, 12 by 3, 12 by 3, 10 by 3, 9 by 2, 15 by 4, 6 by 2, 6 by 1, 6 by 1; tamarack, 14 by 2; all covered with *Alectoria* lichens.

Poor reproduction: 2 black spruce and 2 tamarack "seedlings" (probably vegetative shoots).

Cryptogams: dominant Sphagnum-cover incl. *S. fuscum, S. parvifolium, S. Warnstorfianum, Campylium stellatum, Tomenthypnum nitens.*

The above-mentioned sample plots, Nos. 1 to 22, are all included in Table I, listing the ground vegetation for comparison. The following four sample plots represent more specialized habitats and are not included in Table I:

23. Near the north end of John Lake. A balsam poplar grove on a partly meadow-like gentle slope near the shore of the lake. Now mainly scrub balsam poplar. This was probably once a forest dominated by white spruce. Trees on about 1/40 acre: balsam poplar, 21 by 6, 21 by 5, 21 by 5, 15 by 4, 15 by 3, 15 by 4, 12 by 3, 12 by 2, 12 by 4, 12 by 3, 12 by 2, 12 by 2, 9 by 2. Nearby white spruce reaching 45 by 18 and the biggest balsam poplar seen in the area, 27 by 8.

Bushes: *Alnus crispa*+, *Ribes glandulosum* +, *R.* cfr. *triste*+, *Juniperus communis*+, *Salix vestita*+, *Viburnum edule*+.

Reproduction: only vegetative propagation of poplar.

Ground vegetation: *Rubus pubescens* 2 (the same frequency scale is used here as in Table I), *Fragaria virginiana* 1, *Solidago macrophylla* var. *thyrsoides* 1, *Heracleum lanatum* 1, *Actaea rubra* incl. forma *neglecta* 1, *Geum rivale*+, *Agrostis borealis*+, *Achillea nigrescens*+, *Petasites palmatus*+, *Agropyron trachycaulum*+, *Epilobium angustifolium*+, *Aster puniceus*+, *Viola* sp.+, *Galium triflorum*+, *Rubus strigosus*+, *Senecio pauperculus*+, *Carex scirpoidea*+, *C. atratiformis*+, *C. capillaris*+.

24. West of Denault Lake, northeast of Burnt Creek, on a mountain slope in the uppermost part of the forest region. A small grove with dominant white birch, probably *Betula papyrifera* var. *cordifolia,* of the

sizes: 24 by 8, 24 by 10, 24 by 12, all rotten and all on 1/40 acre with a rich scrub cover including scattered vegetative shoots of the birches. Dominant *Alnus crispa* and *Betula glandulosa* incl. *Betula* cfr. *minor* and a few *Amelanchier Bartramiana* bushes.

No reproduction, except vegetative propagation of the birches.

Ground vegetation: *Ledum groenlandicum* 2, *Vaccinium uliginosum* 2, *V. pensylvanicum* 1, *Lycopodium annotinum* 1, *Deschampsia flexuosa*+, *Cornus canadensis*+, *Solidago macrophylla* var. *thyrsoidea*+.

25. About 1 mile northwest of Burnt Creek. A "subalpine" heath, partly covered by *Betula glandulosa* scrub, near a small brook. The original forest was largely destroyed by a fire about 18 years ago. There are no trees on the sample plot itself, but a few white spruce were noted in the close vicinity. Judging from the dwarf birch scrub, the winter snow cover is about 1 to 2 feet deep.

Reproduction: On 1/40 acre plot were 46 white spruce seedlings 8 to 17 years old, some of them much deformed by wind and snow (See Diagram 2). This sample plot is one of the few places where satisfactory reproduction by seed had occurred after fire on the mountain slopes.

Bushes: *Betula glandulosa* 2.

Ground vegetation: *Vaccinium Vitis-Idaea* 2, *Lycopodium annotinum* (only under *Betula glandulosa*) 1, *Empetrum hermaphroditum*+, *Juncus confusa*+, and the following cryptogams: dominant lichens on the heath, *Cladina alpestris, Cetraria* ssp., *Alectoria* spp., and the mosses *Polytrichum piliferum* and *P. juniperinum.* In the dwarf birch scrub on the sample plot *Sphagnum parvifolium, S. robustum, Pleurozium Schreberi, Polytrichum commune, P. strictum, Dicranum* sp.

26. About 1·5 miles east from Knob Lake. A sample plot on an area which had burned about 23 years ago.

Trees on about 1/40 acre: black spruce, 14 by 2, 12 by 2, 12 by 2, 9 by 1, 6 by 1, 6 by 1, 6 by 1, 4 by 1, 4 by 1, 4 by 1, and 4 by 1; white spruce 7 by 1, incl. 4 larger dead trees.

Reproduction good: 17 white spruce seedlings, 10 to 23 years old; 17 black spruce seedlings, 10 to 21 years old; and 9 tamarack seedlings, 8 to 15 years old (See Diagrams 2 and 4).

Ground vegetation: *Vaccinium pensylvanicum* 2, *V. uliginosum*+, *V. caespitosum* 1, *Epilobium angustifolium*+, *Solidago macrophylla* var. *thyrsoidea*+, *Lonicera villosa*+, *Taraxacum* sp.+, and the following cryptogams: dominant *Pleurozium Schreberi,* incl. *Dicranum Bergeri, D. scoparium, Polytrichum strictum, Pohlia nutans, Aulacomnium palustre,* and scattered lichens (*Cladina mitis, Cladonia* ssp.).

THE FOREST TYPES

The purpose of Table I is to present, in condensed form, beginning with the simplest and ending with the richer and more luxuriant, the

TABLE I

The Ground Vegetation (Vascular Plants) on 22 Sample Plots

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Betula glandulosa	2	1	1	1	–	1	2	2	1	1	2	1	2	2	1	+	+	2	–	+	3	–
Ledum groenlandicum	1	1	+	+	1	+	2	–	+	1	2	1	2	–	–	–	+	–	+	2	1	1
Empetrum nigrum var. *hermaphroditum*	1	1	+	2	2	–	1	2	2	1	1	1	–	+	–	1	1	2	+	2	+	–
Vaccinium uliginosum	1	1	1	1	+	–	–	1	+	1	+	2	–	–	–	–	1	+	–	2	–	1
V. Vitis-Idaea var. *minus*	+	+	–	+	+	–	–	+	+	+	1	+	+	–	–	+	+	–	–	+	–	–
V. caespitosum	1	1	–	–	–	1	+	2	+	–	1	1	+	–	–	1	+	+	–	+	–	–
V. pensylvanicum	+	–	1	–	1	–	+	–	–	2	–	–	–	–	–	–	+	–	–	–	–	–
Lycopodium annotinum	–	+	–	+	–	+	+	1	–	1	+	+	1	–	1	–	+	–	–	–	–	–
Deschampsia flexuosa	–	–	–	–	–	+	+	+	–	–	+	+	–	–	+	–	+	–	–	–	–	–
Geocaulon lividum	–	–	–	–	1	–	–	–	+	–	–	1	–	–	–	–	–	–	–	–	–	–
Lycopodium sitchense	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Solidago multiradiata	–	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Epilobium angustifolium	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	+	+	+	–	–	+	–
Cornus canadensis	–	–	–	–	–	+	–	+	+	+	2	3	+	+	1	2	2	1	–	+	–	–
Petasites palmatus	–	–	–	–	–	–	–	–	–	–	+	+	+	+	1	1	–	+	–	+	–	–
Solidago macrophylla var. *thyrsoidea*	–	–	–	–	–	–	–	–	–	–	+	1	1	–	2	1	+	+	+	–	–	–
Alnus crispa	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–
Salix cfr. *planifolia*	–	–	–	–	–	–	–	–	–	–	–	–	+	2	+	–	–	2	–	1	1	–
Linnaea borealis	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	+	1	1	–	–	+	–
Coptis groenlandica	–	–	–	–	–	–	–	–	–	–	–	+	–	–	+	–	+	+	–	–	–	+
Mitella nuda	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	1	1	–	–	–
Trientalis borealis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–
Viburnum edule	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	1	–	–	–	–	–	–
Rubus acaulis	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	+	–	–	–	–
Rubus strigosus	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–
Luzula parviflora	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	+	1	–	–	–
Geum rivale	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	1	–	–	–
Epilobium Hornemannii	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
Stellaria calycantha	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–	–
Pyrola uniflora	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–	–
Calamagrostis Langsdorffii	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	+	+	–	+	–
Streptopus amplexifolius	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–

TABLE I.—*Concluded*

The Ground Vegetation (Vascular Plants) on 22 Sample Plots—Concluded

—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Salix cfr. *cordifolia*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	2	–	–	–	–	–
Rubus pubescens	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	1	–	–	–
Ribes triste	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	.	–	–	–	–	–
Equisetum sylvaticum	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	+	1	–	–
Equisetum palustre	.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	1	–	–	–	–
Carex cfr. *rostrata*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–
Petasites vitifolius	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–
Rubus Chamaemorus	–	–	–	–	–	–	–	–	.	–	–	.	+	–	–	–	–	–	–	2	2	2
Oxycoccus microcarpus	.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+	+
Chiogenes hispidula	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	+
Kalmia polifolia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+
Chamaedaphne calyculata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	2
Smilacina trifoliata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Carex disperma	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	+
Carex paupercula	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
Carex cfr. *brunnescens*	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	.	–	–	–	1	–
Myrica Gale	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Ranunculus lapponicus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Listera cordata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+

composition and vegetational range of the ground cover of plots 1 to 22. The sample plots are arranged below according to the following tentative classification of main forest types[1]:

Spruce (tamarack) lichen forests: sample plots 1 to 6.
Spruce–dwarf shrub–lichen forests: sample plots 7 and 8.
Spruce feather moss forests: sample plots 9 and 10.
Spruce bunchberry forests: sample plots 11 and 12.
Rich white spruce forests: sample plots 15 to 18 (13).
Rich swamps (fen forests): sample plots 19 (14 and 20).
Open bog forests: sample plots 21 and 22.
Mixed groves: sample plot 23 (not included in Table I).

The dominant forest types in the Knob Lake area are spruce-lichen forest, spruce–dwarf shrub–lichen forest, and rich bog forest. Other types, including the conifer-*Vaccinium* type, are only incompletely developed and, although common, are on the whole rather unimportant. However, because the Knob Lake area is on the border zone between the taiga proper and the forest-tundra, and also between the mountains and the lowland, the forest, naturally, tends to be less homogeneous, with many types represented in a comparatively small area.

THE REPRODUCTION OF THE FORESTS

Notes on the reproductive capacity of these northern forests are scarce in the literature. In the descriptions of the sample plots above, the number of seedlings on each sample plot is given. As in other parts of the northernmost coniferous forests, the quantity of seedlings is satisfactory on the lichen heaths, but growth is severely retarded by a number of unfavourable factors, such as poor soil, snow-damage, and exposure to strong winds on the ridges and terraces where the spruce-lichen forest is common.

In the spruce-lichen forests, the commonest forest type in the area, the spruce seeds germinate readily, especially in small crevices between the lichen; and, wherever larger open patches occur in the lichen cover, spruce seedlings are rarely absent, because they are able here to reach the mineral soil. The same is true also of the more thoroughly investigated pine-lichen heaths in northern Scandinavia. The spruce seedlings, however, grow very slowly and sometimes reach only 1 to 2 feet in height in 50 to 60 years, an extremely slow growth, which is even slower than the growth of pine seedlings in similar habitats in Lapland (See the author's study on the Scotch pine in northernmost Finland, 1948). Diagrams 1 to 4 show the relation between the height of the seedlings and their age.

The feather moss forest types often represent a climax forest, where the reproduction is poor or entirely lacking owing to the dense moss cover. In such a moss cover the spruce seeds may germinate, but the roots do not reach the mineral soil through the thick moss layer. The same is true in forest types with a dense herbaceous ground cover and in the groves which have attained climax stage. In this watershed area there never was any cutting, and the only disturbing factor in the vegetation cycles has been fires, storm damage, or natural decay in the virgin forests.

[1] The author (1949) described the main forest types (tentative) in the Labrador taiga comparing them with those of northern Russia, Scandinavia, and other parts of Canada.

Reproduction seems to be best in rather moist areas where not only tamarack but also the spruce species show satisfactory development of seedlings. Black spruce seedlings grow extraordinarily well in burned swamp forests, showing sometimes terminal glaucous twigs like white spruce seedlings. Balsam fir, which is near its northern limit in this area, reproduces poorly from seed.

About 330 samples of seedling material were collected during my short stay at Knob Lake. Their age has been microscopically determined. Owing to the slow growth, especially on the lichen heaths, the radial growth in some years amounts to only two to three cell layers. Occasionally the radial growth is eccentric to such a degree that a determination of age is impossible. In Table II the age determinations have been summarized. It must be pointed out, however, that many of the determinations are very uncertain and that Table II, therefore, should be regarded only as a first attempt at analysing reproduction in the northern Labrador forests. Renvall (1912) called attention to a possible dormancy period of pine seeds in the northernmost forests in Finland. According to him and others, it seems probable that a number of pine seeds in the North do not germinate the first year, but only after a dormancy period of from 2 to 4 years. If such a period also occurs in the northernmost forests in Labrador, the present determination of age classes and seed years will be even more uncertain.

In Table II no vegetative shoots have been included. At least this has been checked as carefully as possible. Vegetative propagation of black spruce and balsam fir is extremely common in the Labrador forests, but an experienced observer can easily distinguish between true seedlings and vegetative shoots. The eccentric radial growth of black spruce trees on muskeg habitats is often due to the fact that the tree has grown up from a vegetative shoot. A further source of error in the age determination of the seedlings is the ability to form adventitious roots and rooting branches. This is particularly common in black spruce and tamarack, especially on wet habitats where the apical growth of *Sphagnum* is rapid. Thus, I have seen black spruce seedlings, 1 foot high, which in their eighteenth year still formed adventitious roots in order to escape becoming submerged in the "rising" *Sphagnum* cover. If the age of such seedlings is only superficially checked, with a control on the surface of the moss cover only, the age will be incorrectly determined. Age determinations of black spruce on muskegs and of tamaracks on wet areas, therefore, are somewhat uncertain or sometimes even useless, unless the radial growth measurements are properly checked. Compare also Marr (1948) on the radial growth of tamarack.

Thus there are many sources of error in Table II. It suggests, however, that spruce and tamarack produce mature seeds nearly every year, even though, quantitatively, the seed production varies from year to year, as do the conditions for successful germination.

Table II shows that the age class "12" is prominent in white spruce, owing to the fact that 1934 probably was an unusually warm summer in this area. The age class "9" likewise is well represented, because 1938 was probably a good seed year for this species.

TABLE II

Age Determinations of Spruce and Tamarack Seedlings in the Knob Lake Area

Age class: (0 = 1948)	White spruce	Black spruce	Tamarack
1	—	—	—
2	—	—	—
3	1	—	—
4	5	1	—
5	—	—	1
6	1	2	—
7	—	1	—
8	10	4	2
9	11	7	2
10	2	1	1
11	4	6	1
12	19	21	4
13	12	9	2
14	13	3	8
15	11	7	4
16	8	1	1
17	2	6	2
18	—	1	—
19	—	4	1
20	2	3	1
21	—	3	—
22	—	1	2
23	2	3	—
24	2	4	1
25	—	4	—
26	4	1	1
27	3	1	—
28	1	—	—
29	—	—	—
30	—	1	—
31	—	—	—
32	1	1	—
33	1	1	—
34	—	—	—
35	1	1	1
Total	116	98	35

From Table II it may be deduced that, in the Knob Lake forests, black spruce reproduction by seed is perhaps more successful than in either white spruce or tamarack.

Regeneration of the burned forests in the area is generally poor on the mountain slopes. Extensive mountain slope areas which were once forested are now entirely barren, and alpine heaths encroach on areas formerly occupied by forests. This is due to poor regeneration in the upper levels of the forest region. One of the few exceptions is described in sample plot No. 25. Many large fires have occurred in this area. The last was around Burnt Creek in 1947 (See Plates XXXV, XXXVIII to XL), and another must have occurred there some 20 years ago (See localities

Nos. 25 and 26 above). The annual *Corydalis sempervirens* is a characteristic plant of the most recently burned areas in this region. The seeds of *Ribes glandulosum* also frequently germinate on newly burned grounds.

Vaccinium pensylvanicum, V. uliginosum, and *V. caespitosum* all have the capacity (as also has *V. canadense,* which is rare in the area) to form new buds from burned ground stems; therefore these species quickly recover their earlier areas in the burned forest. Burned patches of the feather moss cover (*Hylocomium splendens* and *Pleurozium Schreberi*) also form new vegetative buds on old burned "stems." *Ledum groenlandicum, Betula glandulosa, Geocaulon lividum,* but especially *Epilobium angustifolium,* readily reproduce vegetatively on burned ground. Among the other common forest plants in the area, *Cornus canadensis, Linnaea borealis, Mitella nuda,* and *Deschampsia flexuosa* show resistance to lighter forest fires and readily form new shoots from old stems. Regeneration of the burned areas takes place much in the same manner as in northern Finland and Sweden (See Kujala 1926 and Sarvas 1937).

Different seed years are of different quality, and one may assume that spruce forest at its northern or vertical limit has about the same general ecology as the Scotch pine forest at its northern limit. Investigations show that Scotch pine seed years do not occur every year and that certain temperature requirements are needed before the seed matures in the cones. There are intervals of many years between good seed years in the north, and therefore the large fires are even more devastating. This may partly explain the existence of numerous burned areas in Labrador where, according to observers who have travelled by air from Seven Islands to Knob Lake, no natural afforestation has occurred. The temperature requirements for the production of mature seeds for black spruce or white spruce at their northern limits are still unknown. From the fact that the circumboreal tree-line fairly well coincides with the July 10°C. isotherm, one may assume that the American northern spruce species follow, at least in part, the same ecological laws as do the Scotch pine at its northern limit. Regarding the lengthening interval between good seed years, see Renvall 1912, Hagem 1917, Heikinheimo 1920, Eide 1932, and Hustich 1948.

VEGETATION ON MOUNTAINS, BOGS, AND IN LAKES

The author's notes on vegetation were chiefly concerned with forest habitats so that observations on other habitats are scanty.

The vascular plants occurring in the alpine region of the area are predominantly circumpolar, or widely distributed arctic or subarctic species (*See* Hultén 1937). The highest mountain in the region, Irony Mountain, is about 3,000 feet above sea-level. On an excursion on September 1, 1948, the following plants were collected above the forest limit on the south and southeast slopes:

Arctostaphylos alpina, Loiseleuria procumbens, Phyllodoce coerulea, Diapensia lapponica, Ledum groenlandicum, Vaccinium uliginosum, V. Vitis-Idaea, Empetrum nigrum var. *hermaphroditum, Pyrola grandiflora, Parnassia Kotzebuei, Gnaphalium supinum, Achillea nigrescens, Senecio pauciflorus, Solidago multiradiata, Taraxacum lapponicum, Arnica alpina* ssp. *angustifolia, Bartsia alpina, Dryas integrifolia, Sibbaldia procumbens, Viola labradorica, Arenaria sajanensis, Stellaria longipes, Cerastium alpinum*

var. *glanduliferum, Polygonum viviparum, Poa alpina, Trisetum spicatum, Hierochloe alpina, Deschampsia flexuosa, Agrostis borealis, Carex scirpoidea, C. stylosa, C. atratiformis, C. terrae-novae, C. norvegica, C. Lachenalii, C. vaginata, Scirpus caespitosus, Luzula confusa, Juncus albescens, J. trifidus, Tofieldia pusilla, Betula glandulosa, Salix vestita, S. Uva-ursi, S. herbacea, Juniperus communis, Picea mariana* (prostrate), *P. glauca* (prostrate), *Lycopodium Selago, L. annotinum, L. alpinum, Woodsia glabella.*

Nearly all of these, as well as most of those listed below, occur on mountains of central Finnish Lapland.

On other alpine and subalpine habitats in the watershed area around Knob Lake and Howells River valley, the following additional species were found:

Cassiope hypnoides, Castilleja septentrionalis, Pedicularis groenlandica, P. labradorica, Veronica alpina var. *unalaschcensis, Potentilla nivea, P. norvegica* var. *hirsuta, Ranunculus Allenii, R. pedatifidus, Saxifraga Aizoon, Anemone parviflora, Arabis alpina, Draba glabella, Epilobium anagallidifolium, E. Hornemannii, Stellaria calycantha, Arenaria humifusa, Arenaria groenlandica, Poa glauca, P. alpigena, Festuca brachyphylla, Vahlodea atropurpurea, Carex arctogena, C. nardina, Betula minor, Salix glauca, Cystopteris fragilis, C. montana, Woodsia ilvensis,* etc.

The vegetation of the bogs and fens is shown by Table I, where Nos. 19 to 22 represent bog and wet forests. The fens are more common and characteristic for this sedimentary bedrock area, whereas bogs occur chiefly in the granite-gneiss area elsewhere in the interior of Labrador. The following species are common fen plants in the Knob Lake area:

Aster radula, Solidago macrophylla var. *thyrsoidea, Lonicera villosa, Pyrola minor, Potentilla fruticosa, Fragaria virginiana* var. *terrae-novae, Rubus pubescens, Geum rivale, Parnassia palustris* var. *neogaea, P. Kotzebuei, Salix arctica, S. cordifolia* var. *callicarpaea, S. argyrocarpa, S. vestita, Habenaria dilatata, H. hyperborea, Tofieldia glutinosa, T. pusilla, Schizachne purpurascens, Calamagrostis canadensis* var. *Langsdorffii, Eriophorum viridicarinatum, Scirpus hudsonianus, S. caespitosus* ssp. *austriacus, Carex rostrata, C. interior, C. limosa, Juncus albescens, J. castaneus,* and *Triglochin maritimum.*

Typical bog plants are *Ledum groenlandicum, Chamaedaphne calyculata, Vaccinium uliginosum, Oxycoccus microcarpus, Andromeda glaucophylla, Kalmia polifolia, Empetrum nigrum* var. *hermaphroditum, Drosera rotundifolia, Potentilla palustris, Rubus Chamaemorus, Equisetum sylvaticum, Carex pauciflora, C. paupercula,* and *Eriophorum spissum.* These bog plants are also found in fens and rich wet areas on decaying stumps of tamaracks or spruces, where the pH value almost certainly is lower than in the surrounding fen or swamp itself.

The well-drained shores of lakes and rivers, with moss-covered stones have their own peculiar flora, usually consisting of *Galium labradoricum, Primula laurentiana, Anemone parviflora, Castilleja septentrionalis, Parnassia palustris* var. *neogaea, Salix vestita, Agrostis borealis, Vahlodea atropurpurea,* and *Poa alpigena.*

As previously mentioned, the vascular flora of rivers and lakes is poor in species. The following aquatic plants were found in the area by the author: *Utricularia minor, Menyanthes trifoliata, Nuphar variegatum,*

Ranunculus aquatilis var. *eradicatus*, *Callitriche heterophylla*, *Subularia aquatica*, *Hippuris vulgaris*, *Myriophyllum alterniflorum*, *Potamogeton gramineus* var. *typicus*, *P. filiformis* var. *borealis*, *P. Richardsonii*, *P. alpinus* ssp. *tenuifolius*, *Equisetum fluviatile*, *Sparganium hyperboreum*, *Scirpus acicularis*, *Isoëtes Braunii*, and *Nitella* sp.; some of these occur also in the small ponds in the alpine or "subalpine" region in the area. On the dry muddy shores of such ponds occur *Juncus filiformis*, *Veronica scutellata*, *Carex Oederi* var. *viridula*, *C. vesicaria*, *C. rostrata*, *C. brunnescens*, etc.

A special habitat which is common everywhere in Labrador, north to the forest limit, is the alder (*Alnus crispa*) thicket. In the Knob Lake area the following plants were characteristic for these shade-producing alder thickets: *Solidago macrophylla* var. *thyrsoidea*, *Rubus strigosus*, *Streptopus amplexifolius*, *Calamagrostis canadensis* var. *Langsdorffii*, *Dryopteris spinulosa*, and *Lycopodium annotinum*.

As previously indicated, the writer's investigations in 1948 did not extend to the granite-gneiss area which surrounds the Precambrian sediments of the Knob Lake area. The following list of vascular plants, therefore, is, strictly speaking, only representative of the somewhat richer flora of the sedimentary rocks.

A short visit to Ashuanipi, 200 miles south of Knob Lake and 200 miles north of Seven Islands, gave the author an idea of the area south of the sedimentary bedrock belt. Among the plants noted, *Alnus rugosa* var. *americana* and *Arctostaphylos Uva-ursi* are the only two that were not found in the Knob Lake area.

CATALOGUE OF THE VASCULAR PLANTS

The following catalogue of the vascular plants collected in the Knob Lake area and on Lake Ashuanipi has been prepared and annotated by A. E. Porsild, Chief Botanist of the National Museum of Canada, Ottawa, who has kindly checked my field determinations and named all critical material. A complete set of the collection has been deposited in the National Herbarium of Canada; a duplicate set is in the Botanical Museum in Helsingfors, Finland.

Woodsia glabella R. Br. In crevices of dolomite and shale rock near Burnt Creek and Ruth Lake, Nos. 662, 689, 709-A, and 807.

Woodsia ilvensis (L). R. Br. Rare on cliffs of iron formation near Burnt Creek, No. 802.

Cystopteris fragilis (L.) Bernh. Fairly common in the Burnt Creek area on cliffs and in rock crevices, especially on dolomite (Nos. 627, 654, 684), but also occasionally on rocks of the iron formation, No. 801.

Cystopteris montana (Lam.) Bernh. Rare or occasional. Late snow-covered southeast slope northwest of Burnt Creek, No. 652; in spruce forest west of Lake Wishart, 7 to 8 miles southwest of Burnt Creek, No. 742.

Dryopteris Linnaeana C. Chr. Rare or occasional in rich woods near Lake Gillard, No. 547.

Dryopteris Phegopteris (L.) C. Chr. Rare or occasional in luxuriant forest south of Burnt Creek, No. 696.

Dryopteris spinulosa (O. F. Mull.) Watt. var. **americana** (Fisch.) Fern. Occasional to rare on mountain slopes along brooks, Burnt Creek, Nos. 671 and 711; Lake Wishart, No. 743.

Athyrium Filix-femina (L.) Roth. var. **Michauxii** (Spreng.) Farw. forma **laurentianum** (Butters) Fern. Burnt Creek, along creek with luxuriant vegetation near upper limit of forest, Nos. 698 and 712.

Botrychium Lunaria (L.) Sw. Rare or occasional near Burnt Creek on alpine meadow, Nos. 655 and 765.

Equisetum arvense L. Common. Burnt Creek, growing submerged, No. 828.

Equisetum fluviatile L. Occasional along lake shores, Burnt Creek, No. 824; Lake Gillard, Nos. 497 and 567.

Equisetum palustre L. Noted near Burnt Creek in swampy forest.

Equisetum sylvaticum L. var. **pauciramosum** Milde. Fairly common in swampy forest, Lake Gillard, No. 517.

Equisetum variegatum Schleich. On a bog west of Lake Gillard, No. 564.

Lycopodium alpinum L. Occasional or rare, on north-facing slopes where the snow remains late. Burnt Creek on subalpine dolomite slope, No. 624.

Lycopodium annotinum L. var. **pungens** (LaPylaei) Desv. Burnt Creek, in rich bog in a valley, No. 737; Lake Gillard, in *Hylocomium-Pleurozium* spruce forest, No. 521; Ashuanipi Lake, No. 795.

Lycopodium clavatum L. var. **monostachyon** Grev. & Hook. On exposed subalpine ridge near John Lake, No. 899.

Lycopodium complanatum L. var. **canadense** Vict. Occasional or rare in open spruce-lichen forest and in alpine heath, John Lake, No. 900.

Lycopodium Selago L. Fairly common in boggy places along the watershed where the snow remains late, Burnt Creek, No. 635.

Lycopodium sitchense Rupr. Rare, in black spruce–*Cladina* forest, Burnt Creek, No. 763.

Selaginella selaginoides (L.) Link. Fairly common in boggy places and in moss along brooks. Snow patch slope near Burnt Creek, No. 477.

Isoëtes Braunii Dur. Lake Gillard, on muddy bottom in 2 feet of water, Nos. 511 and 577; muddy bottom of creek near Burnt Creek, No. 904.

Larix laricina (DuRoi) Koch. Common. Lake Gillard, No. 552; exposed, subalpine ridges west of John Lake, No. 901.

Picea glauca (Moench) Voss. Common. Vicinity of Burnt Creek, Nos. 673, 675, and 873; *Cladina* forest near Lake Gillard, No. 486.

Picea mariana (Mill.) BSP. Common. Vicinity of Burnt Creek, Nos. 674 and 872; *Cladina* forest with mixed black and white spruce, Lake Gillard, Nos. 479 and 489; Ashuanipi Lake, No. 766.

Abies balsamea (L.) Mill. Rare or occasional. Swampy depression in sheltered valley southeast of Lake Gillard, No. 514; Ashuanipi Lake, No. 767.

Juniperus communis L. var. **depressa** Pursh. On dolomite cliffs and in open lichen heath, Burnt Creek, Nos. 658 and 705; subalpine region of Irony Mountain, No. 874.

Sparganium angustifolium Michx. In shallow ponds and creeks near Burnt Creek, No. 903. Fertile specimens just past flowering on September 4.

Sparganium hyperboreum Laest. In a shallow pond in black spruce forest near Burnt Creek, No. 764. Specimens with almost mature fruits on August 26.

Potamogeton alpinus Balbis ssp. **tenuifolius** (Raf.) Hult. Among rocks in 2 to 3 feet of water in pond near Lake Gillard, No. 510. Flowering specimens on August 13.

Potamogeton filiformis Pers. var. **borealis** (Raf.) St. John. In shallow water along east shore of Lake Gillard, No. 509. Flowering specimens on August 13.

Potamogeton gramineus L. var. **typicus** Ogden. In a shallow creek, 4 miles east of Burnt Creek, No. 826. Sterile specimens on August 29.

Potamogeton Richardsonii (Bennett) Rydb. Burnt Creek, in a shallow river near Peter Lake, No. 905. Flowering specimens on September 4.

Triglochin maritimum L. In a bog west of Lake Gillard, No. 573.

Hierochloe alpina (Sw.) R. & S. Fairly common in dry alpine heath. Burnt Creek, No. 427.

Alopecurus aequalis Sobol. In subalpine pond near Burnt Creek, No. 716. Flowering specimens on August 24.

Agrostis borealis Hartm. Common in alpine heath and along lakeshores. Burnt Creek, Nos. 415, 441, 680, 836, 869 and 878-A; vicinity of Lake Gillard, Nos. 503, 582, and 614; Lake Ashuanipi, Nos. 787 and 794.

Agrostis scabra Willd. Ashuanipi Lake, No. 775.

Calamagrostis canadensis (Michx.) Nutt. Common on lakeshores, along creeks, and in swampy forest. Vicinity of Burnt Creek, Nos. 443, 706 and 877; vicinity of Lake Gillard, Nos. 515 and 569-A; Ashuanipi Lake, Nos. 784 and 791.

Calamagrostis canadensis (Michx.) Nutt. var. **Langsdorffii** (Link.) Inman. Common, and apparently growing together with the species. Burnt Creek, No. 670; vicinity of Lake Gillard, No. 505-A.

Calamagrostis inexpansa A. Gray. Vicinity of Burnt Creek, in a grove of white spruce and balsam poplar, No. 761 [var. *brevior* (Vasey) Stebbins]; vicinity of Lake Gillard in a creek meadow, Nos. 550 and 569.

Calamagrostis lapponica (Wahlenb.) Hartm. var. **nearctica** Porsild. In a meadow north of Lake Gillard, No. 549.

Calamagrostis neglecta (Ehrh.) Fl. d. Wett. Sandy shores of Ashuanipi Lake, No. 774.

Deschampsia caespitosa (L.) Beauv. var. **glauca** (Hartm.) Lindm. Subalpine tundra plateaux, 30 miles northwest of Burnt Creek, No. 677.

Deschampsia flexuosa (L.) Trin. Common in a variety of habitats, such as recent burns, in spruce–*Hylocomium splendens* forest and in alpine heath. Vicinity of Burnt Creek, Nos. 429, 430, and 476; 30 miles northwest of Burnt Creek, No. 679; Irony Mt., 15 miles of Burnt Creek, No. 870; Lake Gillard, No. 617.

Vahlodea atropurpurea (Wahlenb.) Fr. Occasional in wet, turfy places in vicinity of Lake Gillard, No. 595; edge of summer-dry subalpine pond about one mile north of Burnt Creek, No. 432.

Trisetum spicatum (L.) Richt. Vicinity of Burnt Creek, No. 474; alpine region of Irony Mountain, No. 862; creek meadow near Lake Gillard, No. 572.

Schizachne purpurascens (Torr.) Swallen. In a bog in subalpine forest zone near Burnt Creek, No. 731; on creek meadow near Lake Gillard, No. 571. Also noted in rich white spruce forest near Snelgrove Lake.

Poa alpigena (Fr.) Lindm. Probably common everywhere. Burnt Creek, Nos. 417 and 648-B.

Poa alpina L. Occasional to common on alpine slopes where the snow remains late. Burnt Creek, Nos. 472, 475, 640, and 648-A; Lake Gillard, No. 528; Irony Mountain, No. 859.

Poa glauca M. Vahl. Occasional to common on south facing dolomite cliffs near Ruth Lake, No. 682; Burnt Creek on dolomite rocks, No. 444.

Poa nemoralis L. Among luxuriant vegetation along small creek in subalpine forest near Burnt Creek, No. 884.

Poa pratensis L. Rich grassy places near Burnt Creek, No. 710.

Glyceria striata (Lam.) Hitchc. Occasional or rare on meadow near creek, Lake Gillard, Nos. 498 and 499; the last is var. *stricta* (Scribn.) Fern.

Festuca brachyphylla Schultes. Common in alpine heath on iron formation south of Lake Gillard, No. 557; on south-facing dolomite cliffs near Ruth Lake where it formed 1-foot-tall tussocks, No. 685. By its tall growth and very stiff and scabrous leaves the last number approaches *F. saximontana* Rydb. of the West.

Agropyron trachycaulum (Link.) Malte var. **glaucum** (Pease & Moore) Malte. Snow patch slope, 1½ miles northwest of Burnt Creek, No. 470; in creek meadow near Lake Gillard, No. 570.

Eriophorum angustifolium Roth. Abundant on shores of lakes and ponds and in wet places along brooks. Edge of subalpine pond near Burnt Creek, No. 442; river meadow north of Lake Gillard, Nos. 507 and 599.

Eriophorum russeolum Fr. apud Hartm. Occasional on bogs and fens within the forested area. Subalpine bog near Burnt Creek, No. 806; in a bog west of Lake Gillard, No. 562.

Eriophorum spissum Fern. Common in bogs. Lake Gillard, No. 560.

Eriophorum viridicarinatum (Engelm.) Fern. In a bog on dolomite west of Lake Gillard, No. 586; bog in subalpine forest east of Burnt Creek, No. 733.

Scirpus caespitosus L. ssp. **austriacus** (Pall.) Asch. & Graeb. In *Scirpus hudsonianus–Larix* bogs east of Knob Lake, No. 851; in a bog west of Lake Gillard, No. 536.

Scirpus hudsonianus (Michx.) Fern. Noted on *Larix* bogs near Lake Gillard.

Eleocharis acicularis (L.) R. & S. In muddy bottom of a creek near Burnt Creek, No. 907. Sterile specimens on September 1.

Carex nardina Fr. var. **atriceps** Kük. On south-facing dolomite cliffs in forested area, 2 miles south of Burnt Creek, No. 690.

Carex arctogena H. Smith in Acta Phytogeogr. Suec. **13**:191-200 (1940). See also Porsild, Nat. Mus., Canada, Bull. 121. Occasional to common in turfy places, often near the edge of alpine ponds. Alpine area 2 miles northwest of Burnt Creek, Nos. 435 and 665; west of Lake Wishart, 12 miles west of Burnt Creek, No. 746.

Carex disperma Dewey. In black spruce muskeg near Lake Gillard, No. 594.

Carex trisperma Dewey. In a black spruce–larch muskeg near Lake Gillard, No. 518-A

Carex tenuiflora Wahlenb. On the shore of Lake Gillard, No. 616.

Carex Lachenalii Schk. Snowflushes on alpine plateau near Irony Mountain, No. 878.

Carex Heleonastes Ehrh. in L. fil. In a bog on dolomite west of Lake Gillard, No. 568. A rare species in North America where it has been collected only a few times between the west coast of Hudson Bay and Alaska. The specimens are typical and on August 12 had fully ripe achenes.

Carex brunnescens (Pers.) Poir. Probably common in black spruce muskegs. By edge of subalpine pond south of Lake Gillard, Nos. 558 and 594-A; bog west of Lake Gillard, No. 568; 2 miles south of Burnt Creek, No. 428.

Carex canescens L. var. **subloliacea** Laest. In sphagnum bog or black spruce–larch swamp southeast of Lake Gillard, No. 516.

Carex arcta Boott. Subalpine ravines in mountain ridge west of Lake Wishart, about 12 miles from Burnt Creek, No. 745; shore of subalpine pond south of Lake Gillard, No. 607.

Carex gynocrates Wormskj. Creek meadow north of Lake Gillard, No. 601; in a bog south of Lake Gillard, No. 596.

Carex interior Bailey. In a bog between John Lake and Knob Lake, No. 835.

Carex deflexa Hornem. On dry mountain slopes, 2 miles south of Burnt Creek, No. 425; shore of summer dry pond near Lake Gillard, No. 606.

Carex scirpoidea Michx. Common on fens and on alpine slopes, especially on dolomite, Burnt Creek, Nos. 478-C, 667, 669 and 867; Lake Gillard, No. 540.

Carex concinna R. Br. Steep, southwest facing dolomite cliffs, 2 miles south of Burnt Creek, No. 691 and 705-A.

Carex terrae-novae Fern. See Rhod. **44**:290 (1942). On dry alpine heath on windblown ridges of the iron formation, Burnt Creek, Nos. 424 and 663; Lake Gillard, No. 615.

Carex vaginata Tausch. Fairly common on subalpine slopes. Burnt Creek, No. 863; in a bog west of Lake Gillard, No. 591.

Carex capillaris L. Common on fens and on creek meadows. Burnt Creek, No. 478-G; Lake Gillard, Nos. 501 and 543.

Carex Oederi Retz. var. **viridula** Kük. Edge of small pond, Burnt Creek, No. 719.

Carex rariflora (Wahlenb.) Sm. Common in bogs, Lake Gillard, No. 593.

Carex limosa L. In a bog west of Lake Gillard, No. 533.

Carex paupercula Michx. Common in bogs and in open bog forest. Burnt Creek, No. 422; Lake Gillard, Nos. 518 and 565.

Carex norvegica Retz. On alpine slopes, often around dolomite blocks on ridges of the iron formation. Burnt Creek, Nos. 445, 445-A, 666, and 860; Lake Gillard, No. 548.

Carex stylosa C. A. Mey. In turfy places, Irony Mt., No. 876; Lake Wishart, No. 744; Lake Gillard, No. 618.

Carex atratiformis Britt. Burnt Creek, in subalpine meadow, No. 459; on snowflush slope, No. 645; creek meadow near Lake Gillard, No. 544.

Carex Goodenoughii Gay. In turfy places by the edge of subalpine pond near Lake Gillard, No. 559.

Carex aquatilis Wahlenb. Common in wet places along stream and lakeshores, Burnt Creek, No. 827; Lake Gillard, Nos. 496, 538, and 598.

Carex Bigelowii Torr. In turfy places of the subalpine region one mile north of Burnt Creek, No. 434; southeast slope, 1 to 5 miles northwest of Burnt Creek, No. 642; Irony Mountain, 15 miles north of Burnt Creek, No. 864.

Carex pauciflora Lightf. In sphagnum bog, 3 to 4 miles east of Burnt Creek, No. 820.

Carex miliaris Michx. Burnt Creek, edge of small pond, No. 727; subalpine tundra in Goodwood area 20 miles northwest of Burnt Creek, No. 678; Ashuanipi Lake, No. 786.

Carex vesicaria L. Occasional along the shore of alpine ponds near Lake Gillard, Nos. 555 and 608; Ashuanipi Lake, No. 796.

Carex rostrata Stokes. Common in water along the edge of ponds; Burnt Creek, Nos. 438, 439, 724, 805 and 834; Lake Gillard, No. 603.

Juncus albescens (Lge.) Fern. Edge of summer-dry alpine pond, No. 604.

Juncus castaneus Sm. Occasional along creeks and ponds, Lake Gillard, Nos. 500 and 526.

Juncus filiformis L. Common by edge of subalpine pond south of Lake Gillard, No. 554; Ashuanipi Lake, No. 785.

Juncus trifidus L. Burnt Creek, common on dry, alpine heaths, No. 433.

Luzula confusa Lindeb. Burnt Creek, common on dry, alpine heaths, No. 426.

Luzula multiflora (Retz.) Lej. var. **frigida** (Buch.) Lam. Rare, on tundra plateau near Goodwood, 30 miles northwest of Burnt Creek, No. 681.

Luzula parviflora (Ehrh.) Desv. Common in forested area in rich soil, Burnt Creek, Nos. 416 and 644.

Tofieldia pusilla (Michx.) Pers. Common in wet turfy places. Burnt Creek, No. 738; Irony Mt., No. 867-A; Lake Gillard, No. 587.

Tofieldia glutinosa (Michx.) Pers. Rare or occasional in *Larix–Scirpus hudsonianus* bog, east of Knob Lake, No. 841.

Smilacina trifolia (L.) Desf. Common in sphagnum bogs and muskegs, Lake Wishart, No. 748A.

Streptopus amplexifolius (L.) DC. var. **americanus** Schultes. Occasional in alder thickets along creeks, Burnt Creek, No. 714.

Habenaria dilatata (Pursh) Gray. Occasional on rich bogs of subalpine forest area. Burnt Creek, Nos. 728 and 754; Lake Gillard, No. 612.

Habenaria hyperborea (L.) R. Br. Occasional on *Larix–Scirpus hudsonianus* bogs, Burnt Creek, No. 840; Lake Gillard, No. 524.

Listera cordata R. Br. Occasional in *Hylocomium-Pleurozium* spruce forest, Lake Gillard, No. 531.

Populus tacamahacca Mill. Rare and only seen twice in the area, near John Lake, Nos. 749 and 852.

Salix arctica Pall. var. **kophophylla** (Schneid.) Polunin. In a bog near Lake Gillard, No. 590.

Salix argyrocarpa Anders. Along creek meadow north of Lake Gillard, No. 545.

Salix Bebbiana Sarg. In a *Larix–Scirpus hudsonianus* bog near Knob Lake, No. 845; black and white spruce forest near Lake Gillard, No. 480; Ashuanipi Lake, No. 779.

Salix cordifolia Pursh var. **callicarpaea** (Trautv.) Fern. Burnt Creek, stony subalpine slope, No. 450; rich *Larix–Scirpus hudsonianus* bog near Knob Lake, No. 849.

Salix cordifolia Pursh var. **Macounii** (Rydb.) Schneid. Rich *Larix–Scirpus hudsonianus* bog near Knob Lake, No. 844.

Salix glauca L. Among lush vegetation along subalpine creek near Burnt Creek, No. 882.

Salix herbacea L. Occasional on snow patch slopes near Burnt Creek, No. 461.

Salix humilis Marsh. Ashuanipi Lake, Nos. 780 and 782.

Salix pedicellaris Pursh var. **hypoglauca** Fern. Rich *Larix–Scirpus hudsonianus* bog near Knob Lake, No. 848; black spruce–larch swamp near Lake Gillard, No. 519-A.

Salix pellita Anders. In subalpine forest near Burnt Creek, No. 886.

Salix planifolia Pursh. Near head of creek from Lake Gillard, No. 502; Ashuanipi Lake, No. 778.

Salix Uva-ursi Pursh. Common on open, stony subalpine heath. Burnt Creek, No. 452; Irony Mt., No. 880.

Salix vestita Pursh. Fairly common on dolomite rock. East of Knob Lake, No. 853; east shore of Lake Gillard, No. 493; Irony Mt., No. 875.

Myrica Gale L. Swampy shore of Knob Lake, No. 808; Ashuanipi Lake, No. 783.

Alnus crispa (Ait.) Pursh. Very common along shores of lakes and rivers, in swampy forest, and on subalpine slopes. Burnt Creek, Nos. 437, 695 and 762; Lake Gillard, No. 494; Ashuanipi Lake, No. 770.

Alnus rugosa (DuRoi) Spreng. var. **americana** (Regel) Fern. Ashuanipi Lake, No. 769. Not seen in the Knob Lake area.

Betula borealis Spach. Burnt Creek, Nos. 797 and 833.

Betula glandulosa Michx. Common and inhabiting a variety of habitats. Burnt Creek, No. 449 and 803; Ashuanipi Lake, No. 772 (? x *borealis*).

Betula Michauxii Spach. See Rhodora **52**:25-34 (1950). Noted but once on a bog between John Lake and Knob Lake, No. 832.

Betula minor (Tuckerm.) Fern. Apparently common in the vicinity of Burnt Creek, Nos. 436, 446, 447, 448, 704, 741, and 813; Lake Gillard, 3 ft. high bushes, No. 551; Ashuanipi Lake, Nos. 768 and 771.

Betula papyrifera Marsh var. **cordifolia** (Regel) Fern. Stony slope one mile south of Burnt Creek, No. 798; in subalpine forest, 5 to 6 miles northeast of Burnt Creek, No. 814; Ashuanipi Lake, No. 788.

Betula pumila L. ? var. **renifolia** Fern. In a rich *Larix–Scirpus hudsonianus* bog east of Knob Lake, No. 846.

Urtica gracilis Ait. Noted but once in *Heracleum lanatum–Salix glauca* thicket near Burnt Creek, No. 883.

Geocaulon lividum (Richards.) Fern. Common near Burnt Creek in spruce forest, Nos. 730 and 823; Ashuanipi Lake, No. 776.

Polygonum viviparum L. Common on alpine slopes and along creeks. Burnt Creek, Nos. 478-D and 709-B; Lake Gillard, No. 611.

Stellaria calycantha (Ledeb.) Bong. Along brooks, moist wooded slopes, etc., Burnt Creek, Nos. 414, 465, and 812; Lake Gillard, No. 580.

Stellaria longipes Goldie s. lat. Apparently rare and noted but once in alpine zone of Irony Mt., No. 855.

Cerastium alpinum L. var. **glanduliferum** Koch. Alpine upper slope of Irony Mt., No. 871.

Cerastium arvense L. Burnt Creek, along stony brook near timberline, No. 413; snow-patch slope, No. 650.

Arenaria groenlandica (Retz.) Spreng. Common in wet gravelly places on mountain ridges near Burnt Creek, Nos. 440 and 478-A.

Arenaria humifusa Wahlenb. Apparently not uncommon in snow-patch areas and on alpine slopes near Burnt Creek, Nos. 478B, 638, 668, and 800; subalpine region west of Lake Wishart, No. 747.

Arenaria macrophylla Hook. On subalpine dolomite slope and on shale cliffs or in rich white spruce forest. Burnt Creek, Nos. 464, 626, and 708.

An interesting species of peculiar disrupted range of which there are but two earlier Ungava collections in the National Herbarium: Lake Michikamow, A. P. Low, July 27, 1894, Can. 4344, and Northern Labrador, August 16, 1896, Spreadborough, Can. 16280.

Arenaria sajanensis Willd. Alpine slopes of Irony Mt., 15 miles north of Burnt Creek, No. 856.

Arenaria uliginosa Schleich. Alpine summits in areas of soil flow, 2 miles northwest of Burnt Creek, No. 664.

Nuphar variegatum Engelm. Occasional in ponds and small lakes, including the subalpine region. Burnt Creek, No. 897. Flowering specimens on September 2.

Coptis groenlandica (Oed.) Fern. Noted as fairly abundant in spruce forest. See Table I.

Actaea rubra (Ait.) Willd. Noted but once, in the balsam poplar grove near John Lake where typical specimens, No. 751, grew side by side with the white fruited forma *neglecta* (Gillman) Robins., No. 750.

Anemone parviflora Michx. Common on subalpine slopes and on snowflushes, preferably on soil derived from dolomite. Burnt Creek, Nos. 463, 647, and 707; Lake Gillard, No. 523.

Ranunculus Allenii Robins. Noted but once on subalpine dolomite slope near Burnt Creek, No. 646.

Ranunculus aquatilis L. var. **eradicatus** Laest. In subalpine pond 1 mile east of Burnt Creek, No. 722; in a creek flowing north from Lake Gillard, No. 512. Flowering and fruiting specimens on August 24 and 12, respectively.

Ranunculus lapponicus L. Occasional in swampy forest and along brooks, Lake Gillard, No. 527.

Ranunculus pedatifidus Sm. Occasional in subalpine meadows where it is often associated with *Potentilla norvegica, Trisetum spicatum*, etc., Burnt Creek, No. 454.

Corydalis sempervirens (L.) Pers. Common in recent burns and in rocky places, Burnt Creek, Nos. 423 and 693.

Subularia aquatica L. In shallow, subalpine pond, 1 mile east of Burnt Creek, No. 717; Lake Gillard, with *Callitriche anceps*, on muddy bottom of shallow pond, No. 576.

Rorippa islandica (Oed. ex Murr.) Borbas var. **microcarpa** (Regel) Fern. Occasional in meadows and on freshly exposed soil, Burnt Creek, Nos. 455 and 811.

Cardamine pratensis L. Sterile basal rosette from a brook bed near Lake Gillard, No. 578.

Draba glabella Pursh. On dolomite cliffs in wooded area 2 miles south of Burnt Creek, No. 688.

Draba nivalis Liljebl. Dolomite cliffs northwest of Burnt Creek, No. 478-E.

Arabis alpina L. Along stony creek near timberline, Burnt Creek, No. 411.

Drosera rotundifolia L. Sparingly in a *Larix–Scirpus hudsonianus* bog east of Knob Lake, No. 842.

Saxifraga Aizoon Jacq. On south-facing dolomite cliffs 2 miles south of Burnt Creek, Nos. 686 and 709-C. The only species of *Saxifraga* noted in the Knob Lake area.

Mitella nuda L. Common in rich white spruce woods where it ascends to near timberline, Burnt Creek, No. 466.

Parnassia Kotzebuei Cham. & Schlecht. Fairly common along brooks and on wet rocky slopes on shale and dolomite. Burnt Creek, No. 457; Lake Gillard, Nos. 505 and 613.

Parnassia palustris var. **neogaea** Fern. Fairly common along the shore of Lake Gillard, Nos. 525 and 602; in sphagnum in *Larix–Scirpus hudsonianus* bog east of Knob Lake, No. 843.

Ribes glandulosum Grauer. The common species in wooded parts of the area and on recent burns. Burnt Creek, Nos. 418 and 823-A; Lake Gillard, Nos. 584 and 609. Almost mature fruits on August 18.

Ribes triste Pall. var. **albinervium** (Michx.) Fern. In rich woods near Lake Gillard, Nos. 492 and 583. Mature fruits on August 18.

Sorbus decora (Sarg.) Schneid. var. **groenlandica** (Schneid.) Jones. Noted but once in a small mountain valley near Burnt Creek where it grew together with balsam fir and formed small thickets, No. 694. The collector noted that all bushes were sterile on August 23.

Amelanchier Bartramiana (Tausch) Roem. Small thickets along the shore of subalpine pond near Lake Gillard, No. 522; subalpine dolomite slope near Burnt Creek, No. 623. Both specimens are sterile and do not appear to have flowered in 1948.

Rubus acaulis Michx. Occasional in rich subalpine spruce forest, Burnt Creek, Nos. 468 and 637.

Rubus Chamaemorus L. Common on bogs and in wet turfy places. Burnt Creek, No. 829; Goodwood area, 30 miles northwest of Burnt Creek, No. 659-H.

Rubus pubescens Raf. Fairly common in rich woods and along creeks, Burnt Creek, No. 702; Lake Gillard, No. 579. Specimens collected on August 23 were just past flowering.

Rubus strigosus Michx. Occasional in rich woods along streams, Burnt Creek, No. 756; Lake Gillard, No. 574. Small, green but fully formed fruits on August 23.

Fragaria virginiana Duchesne var. **terrae-novae** (Rydb.) Fern. Subalpine meadows near Burnt Creek, Nos. 460 and 629; in a bog near Lake Gillard, No. 537. All specimens had flowered, but by August 20 the receptacles were wilted and dead.

Potentilla fruticosa L. Common in bogs and in *Larix* swamps. Lake Gillard, No. 539.

Potentilla nivea L. Noted but once on south-facing dolomite cliffs south of Burnt Creek growing with *Saxifraga Aizoon* and *Carex nardina* var. *atriceps*, No. 683.

Potentilla norvegica L. Summer dry creek bottom south of Burnt Creek, No. 458, var. *labradorica* (Lehm.) Fern.; Ashuanipi Lake, No. 793 is var. *hirsuta* (Michx.) Lehm.

Potentilla palustris (L.) Scop. Boggy places in black spruce muskeg, Burnt Creek, No. 421; Lake Gillard, No. 588.

Potentilla tridentata Sol. Sunny cliffs and ridges west of John Lake, No. 900-A.

Sibbaldia procumbens L. On snowflushes northwest of Burnt Creek, No. 649.

Geum rivale L. Fairly common in rich woods along creek near Burnt Creek, No. 419.

Dryas integrifolia M. Vahl. Occasional or rare in alpine slopes, 2 miles northwest of Burnt Creek, No. 661; summit of Irony Mt., 15 miles north of Burnt Creek, No. 865.

Alchemilla filicaulis Buser. Rare along creek half a mile east of Burnt Creek, No. 715.

Callitriche anceps Fern. In muddy bottom of shallow pond near Lake Gillard, No. 576-A.

Callitriche heterophylla Pursh. In a small pond 1 mile east of Burnt Creek camp, No. 721.

Empetrum nigrum L. Very common on dry slopes, open forest and in bogs. Fruiting specimens on August 18 at Lake Gillard in *Cladonia*–spruce forest, No. 622 (var. *hermaphroditum* (Lge.) Sör.).

Viola labradorica Schrank. By the collector noted as the most common violet in the area, occurring in subalpine meadows, in rocky places, and in dry places in spruce forest. Burnt Creek, Nos. 462, 653, and 758; Irony Mt., No. 858; alpine plateau near Goodwood, No. 659-I.

Viola pallens (Banks) Brainerd. Stony slope near Burnt Creek, No. 799.

Epilobium anagallidifolium Lam. On snowflushes northwest of Burnt Creek, No. 643.

Epilobium angustifolium L. Common, especially in recent burns. Burnt Creek, Nos. 809 and 810, the last is f. *albiflora.*

Epilobium Hornemannii Reichenb. In moss along alpine brook, Burnt Creek, No. 412.

Epilobium palustre L. Common in boggy places and along creeks. Lake Gillard, Nos. 506 and 610.

Myriophyllum alterniflorum DC. Occasional in sluggish streams. Burnt Creek, Nos. 825 and 906; Ashuanipi Lake, No. 773.

Hippuris vulgaris L. Common in shallow ponds. Burnt Creek, No. 723; Lake Gillard, Nos. 507 and 535.

Heracleum lanatum Michx. Fairly common in rich thickets along streams. Burnt Creek, No. 885.

Cornus canadensis L. Common in open woods as well as on alpine barrens. Burnt Creek, No. 631; Lake Gillard, No. 490.

Cornus stolonifera Michx. Apparently rare and noted but once in alder thickets near Burnt Creek, No. 699.

Moneses uniflora (L.) Gray. Occasional in rich woods. In *Hylocomium-Pleurozium*-spruce forest near Lake Gillard, No. 530.

Pyrola asarifolia Michx. var. **incarnata** (Fisch.) Fern. In rich bog east of Knob Lake, No. 850; subalpine dolomite slope south of Burnt Creek, No. 630.

Pyrola grandiflora Rad. Dolomite cliffs south of Burnt Creek, No. 692; alpine slopes of Irony Mt., No. 854.

Pyrola minor L. Occasional in swampy woods. Burnt Creek, Nos. 431 and 837; Lake Gillard, No. 585.

Pyrola secunda L. var. **obtusata** Turcz. Rare on alpine slope west of Lake Wishart, No. 740.

Ledum groenlandicum Oed. Common in muskegs and open forest. Lake Gillard, No. 619.

Loiseleuria procumbens (L.) Desv. Occasional on mountain heaths and on north-facing slopes. Subalpine slopes west of Lake Wishart, No. 748.

Kalmia polifolia Wang. Common in bogs. Burnt Creek, No. 736.

Phyllodoce coerulea (L.) Bab. Occasional on snowflushes near Burnt Creek, No. 641-A; common on alpine plateau in Goodwood area, Nos. 659-B and 672.

Cassiope hypnoides (L.) Don. Rare on alpine tundra in Goodwood area, No. 676.

Andromeda glaucophylla Link. Occasional in subalpine bogs near Burnt Creek, No. 804.

Chamaedaphne calyculata (L.) Moench. Common on bogs. Burnt Creek, No. 735.

Arctostaphylos alpina (L.) Spreng. Common on alpine, gravelly slopes. Burnt Creek, No. 451.

Arctostaphylos Uva-ursi (L.) Spreng. Not seen in the Knob Lake area, but collected at Ashuanipi Lake, No. 792 (var. *adenotricha* Fern. & McBride).

Chiogenes hispidula (L.) T. & G. Common in bogs and in swampy forest. No. 830, collected east of Burnt Creek, on August 29 had fully mature fruits.

Oxycoccus microcarpus Turcz. Fairly common in sphagnum bogs, Burnt Creek, No. 831.

Vaccinium canadense Kalm. Noted as rare at Burnt Creek; fruiting specimens collected on sandy banks of Ashuanipi Lake, on August 28, No. 789.

Vaccinium caespitosum Michx. Common in wet places in spruce-lichen forest. Sterile specimens collected near Lake Gillard on August 13, No. 485.

Vaccinium pensylvanicum Lam. Common in dry woods. Burnt Creek, No. 482; specimens with almost mature fruit collected on August 19 near Lake Gillard, No. 621; Ashuanipi Lake, No. 790.

Vaccinium uliginosum L. Common in dry woods and on alpine heaths. Flowering specimens on August 21 on alpine plateau, 30 miles northwest of Burnt Creek, No. 659-G; Lake Gillard, Nos. 481 and 620; the last with fully ripe fruits on August 19.

Vaccinium Vitis-Idaea L. var. **minus** Lodd. Noted as common in bogs, dry open woods, and in lichen heath. See Table I.

Diapensia lapponica L. Occasional on alpine barrens. Burnt Creek, No. 453; alpine plateau 30 miles northwest of Burnt Creek, No. 659-E.

Primula laurentiana Fern. Alpine plateau 30 miles northwest of Burnt Creek, No. 659-F; rocky lakeshore near Lake Gillard, No. 542.

Trientalis borealis Raf. Noted by the collector as occasional to common in "spruce-feather moss or bunchberry forest." See Table I.

Menyanthes trifoliata L. In a pond west of Lake Gillard, No. 566.

Veronica alpina L. var. **unalaschcensis** Cham. & Schlecht. Occasional on subalpine meadows and on snowflushes. Burnt Creek, Nos. 456 and 636; alpine plateau 30 miles northwest of Burnt Creek, No. 659-C.

Veronica scutellata L. On the shore of subalpine ponds, Burnt Creek, No. 718; Lake Gillard, No. 575.

Castilleja septentrionalis Lindl. Alpine slopes and stony lakeshores. Burnt Creek, No. 651; Lake Gillard, No. 532.

Bartsia alpina L. Noted but once, on alpine slopes of Irony Mt., No. 864.

Rhinanthus groenlandicus Chab. Occasional on subalpine meadows. Burnt Creek, No. 660.

Pedicularis groenlandica Retz. Apparently rare and noted only once, on alpine plateau, 30 miles northwest of Burnt Creek, No. 659 A.

Pedicularis labradorica Wirsing. Apparently rare and noted only on alpine tundra south of Lake Gillard, No. 556.

Pinguicula vulgaris L. Occasional or rare on wet cliffs near John Lake, No. 821.

Utricularia minor L. Sterile specimens collected on September 2 in a brook in subalpine forest near Burnt Creek, No. 898.

Galium labradoricum Wieg. Occasional in mossy places by lakeshores. Lake Gillard, Nos. 581 and 597.

Galium triflorum Michx. Uncommon or rare. In a poplar grove near John Lake, No. 757; in thickets by a creek near Burnt Creek, No. 703.

Viburnum edule (Michx.) Raf. Occasional in rich woods ascending to near timberline. John Lake, No. 755; Burnt Creek, No. 700; Lake Gillard, No. 491. Fruiting specimens on August 26.

Linnaea borealis L. var. **americana** (Forbes) Rehder. Very common in rich woods and on mountain slopes. See also Table I. Burnt Creek, Nos. 469 and 656; Lake Gillard, No. 546.

Lonicera villosa (Michx.) R. & S. Occasional in swampy places, alpine plateau, 30 miles northwest of Burnt Creek, No. 659-D; Lake Gillard, No. 589.

Solidago macrophylla Pursh var. **thyrsoidea** (Mey.) Fern. Common in rich woods and on lakeshores and on fens. Burnt Creek, Nos. 420, 625, 752 and 847; Lake Gillard, Nos. 483 and 553; Ashuanipi Lake, No. 777.

Solidago multiradiata Ait. Common in dry lichen forest and in alpine tundra. Burnt Creek, Nos. 687 and 759; Irony Mt., No. 868; Lake Gillard, No. 563.

Aster ? foliaceus Lindl. A single, immature specimen of what is probably this species was collected on August 14 near head of creek flowing from Lake Gillard, No. 508.

Aster puniceus L. Occasional in rich thickets along creeks. Burnt Creek, No. 697; Lake Gillard, No. 534.

Aster radula Ait. Common in rich bogs. Burnt Creek, No. 734; Lake Gillard, No. 529.

Antennaria pygmaea Fern. On snowflushes northwest of Burnt Creek, No. 471.

Antennaria ungavensis (Fern.) Malte. On snowflushes northwest of Burnt Creek, No. 639.

Gnaphalium supinum L. On snowflushes northwest of Burnt Creek, No. 641.

Achillea nigrescens (E. Mey.) Rydb. Common in alpine meadows. Dolomite slope south of Burnt Creek, No. 628.

Petasites palmatus (Ait.) Gray. Common in rich woods and on lakeshores. Burnt Creek, No. 467; Lake Gillard, No. 600.

Petasites sagittatus (Banks) Gray. Swampy places in white spruce forest west of John Lake, No. 838.

Petasites vitifolius Greene. Occasional on pond shores near John Lake, Nos. 760 and 839; near Burnt Creek, No. 720.

Arnica alpina (L.) Olin ssp. **angustifolia** (J. Vahl) Maguire. Alpine summit on Irony Mt., No. 861.

Senecio pauciflorus Pursh. Snowflushes northwest of Burnt Creek, Nos. 473 and 632; by a creek near Lake Gillard, No. 495.

Senecio pauperculus Michx. In a poplar grove near John Lake, No. 753.

Hieracium groenlandicum Arv.-Touv. In white spruce forest west of Lake Wishart, No. 739. Flowering specimens on August 25.

Taraxacum lapponicum Kihl. On snowflushes near Burnt Creek, Nos. 478-F and 633; lake shore near Lake Gillard, No. 541.

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74811—15

BOBASATRANIA? CANADENSIS (LAMBE), A GIANT CHONDROSTEAN FISH FROM THE ROCKY MOUNTAINS

By Loris S. Russell

ABSTRACT

"Platysomus" canadensis Lambe, a species of chondrostean fish, is based on a large and nearly complete specimen from the Lower Triassic near Banff, Alberta. It does not belong to the genus *Platysomus*. A new specimen, representing the posterior part, has been found near Fernie, British Columbia. This is even larger than the type specimen. Closest resemblances are to species of *Ecrinesomus* and *Bobasatrania*, but it is concluded that an undescribed genus is represented. The available material is not adequate for a generic diagnosis, and it is proposed to use provisionally the name *Bobasatrania? canadensis* (Lambe).

INTRODUCTION

One of the most striking fossils in the collection of the National Museum of Canada is the type specimen of *Platysomus canadensis* Lambe (1914), consisting of the skeleton, scales, and impression of a very large chondrostean, with deeply rhombic body outline and a large and gracefully bifurcate tail. The specimen was found and collected by W. E. Peyto of Banff, Alberta, and came to the National Museum through N. B. Sanson, the curator of the Banff Museum. Unfortunately, Peyto did not reveal the locality of his find, at least to the scientific world, and all that was known was that it came from near Johnston Creek (Lambe, 1916, p. 36), a tributary of Bow River about 12 miles northwest of Banff, Alberta. In his original description Lambe suggested that the fossil was of Permian age, but later (Lambe 1916), in describing fishes from near Massive, he assigned Peyto's specimen along with his new material to the Upper Banff shale of McConnell. In the same place, Lambe quoted E. M. Kindle as stating that a collection of invertebrate fossils from the Upper Banff shale was determined by G. H. Girty as Lower Triassic (*Meekoceras* beds). This correlation has been accepted by subsequent workers, but Kindle (1924) in his revision of the nomenclature substituted the name Spray River formation for Upper Banff shale. It is still most plausible to assume that Peyto's fossil came from the Spray River formation and that it is of Triassic, and probably of very early Triassic, age (Warren, 1945).

It has long been recognized by students of fossil fishes that *"Platysomus" canadensis* differed markedly from other known species of *Platysomus*. For example, Sir Arthur Smith Woodward, visiting the National Museum of Canada in 1933, expressed the opinion that some genus other than *Platysomus* was represented. Not only is the size of the Canadian specimen far in excess of that found in other species, but the high position of the pectoral fins is in strong contrast to the marginal position characteristic of *Platysomus*. Lambe clearly pointed out the features that distinguished *"P" canadensis* from all other species but evidently did not regard these differences as of generic rank. With the description of the

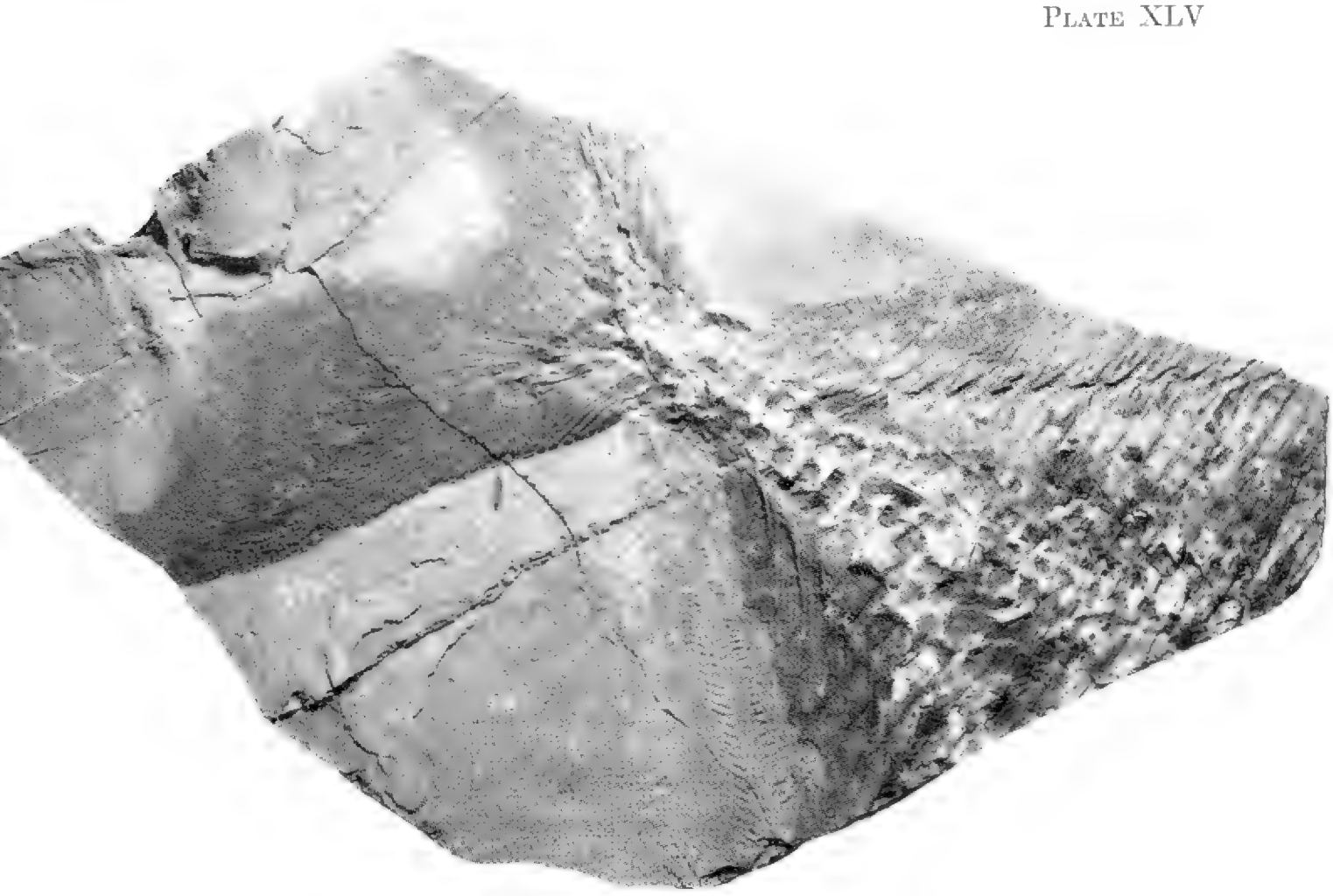
Triassic fishes of Madagascar by A. S. Woodward, F. Priem, and E. I. White, genera were established with which "*Platysomus*" *canadensis* could be compared. Stensiö (1932, p. 126) stated definitely that the Canadian specimen did not represent *Platysomus* but either belonged to *Bobasatrania* or was representative of a new genus.

A species of more normal dimensions was described by Warren (1936) as *Platysomus brewsteri*, the type of which came from about 50 miles southeast of Jasper, Alberta, but probably also from the Spray River formation. This specimen, although imperfect, resembles the type of "*Platysomus*" *canadensis* in all important characteristics except size. The latter is about three and a half times the former in linear dimensions. Any revision of the systematic position of "*Platysomus*" *canadensis* must also involve that of "*Platysomus*" *brewsteri*.

DESCRIPTION OF NEW MATERIAL

The occasion for reviewing the status of "*Platysomus*" *canadensis* arises from the discovery of a second specimen of this species. This specimen came from an excavation on Fairy Creek, near Fernie, British Columbia, made during the construction of a water system for that town. It was obtained during blasting operations and was almost certainly damaged at that time. Mr. Harry Miard of Fernie presented the specimen to the National Museum of Canada, and it has been catalogued under the number 8865.

PLATE XLV



Bobastrania ? *canadensis* (Lambe). N.M.C. No. 8865, from Triassic near Fernie, British Columbia; approximately $\frac{1}{8}$ natural size.

Lack of precise geographical and geological data on the discovery site prevents dating of the fossil on geological evidence. The characteristic rock in the vicinity of Fernie is the Fernie formation, dark grey shale with limestone beds, representing the Lower and Middle Jurassic. The rock on which the present specimen is preserved could have come from the Fernie formation, but the fish itself is of a type very unlikely to have persisted into Jurassic time. We must assume, as in the case of Peyto's specimen, that the age is Triassic, and that the rock is part of the local equivalent of the Spray River formation.

The specimen from Fernie is preserved on a flat slab of calcareous shale, somewhat arenaceous, hard, and dark brown to black in colour. This rock was described by the discoverer of the specimen as "platy sandstone interbedded in limestone." Only a part of the fish is represented (Plate XLV), approximately the posterior third. It is estimated that total length of the complete fish would be about 1600 mm. The preservation is partly as scales and bones, partly as impressions. Much of the squamation appears in inside view, although one seems to be viewing the fish from the right side. The vertebral column is obscurely preserved, although there are indications of centra as well as neural and haemal arches. The ventral spines in the preserved part become progressively directed forward as well as downward, until, near the caudal pedicle, they almost parallel the anal margin.

The dorsal fin is represented by about 250 mm. of its posterior part. The radials are obscure. The rays branch dichotomously to form a continuous and delicate fin, the outline of which, in the part preserved, closely parallels the dorsal margin. Width of the dorsal fin, at right angles to its margins, is about 63 mm. The ventral fin is very similar and is represented by about 360 mm. of its length. The radials appear as a single series of impressions, representing short, rod-like structures spaced about 7 mm. between centres. The rays are like those of the dorsal fin but not as long in the part preserved. Unlike the dorsal fin, the ventral fin has a distal margin that converges slowly on the anal margin of the body from front to rear.

The caudal fin (Plate XLVI) is a striking feature of the specimen, even in imperfect condition. It is relatively larger and more spreading than in the type of "*Platysomus*" *canadensis*, but is otherwise similar. It is widely and symmetrically bifurcate, although clearly heterocercal internally. The caudal pedicle is very constricted, having a width of about 82 mm. at its widest point but appears relatively stouter than this part of the type of "*P.*" *canadensis*. Vestiges of the vertebral column can be followed for about 153 mm. into the dorsal lobe. Marginal to this axis, on the antero-dorsal side, there are three or four rows of special scales. The outermost row consists of narrowly ovoid scales with tapering ends. These scales lie side-by-side, obliquely, their long axes trending posteriorly as well as dorsally. A well-preserved example of these scales measures 108 mm. in length and 13 mm. in width. The second row of scales is a linear series of V-shaped plates, the point of one scale fitting into the notch of the adjacent scale on the proximal side. The innermost row or rows consist of narrowly elongate and pointed scales, arranged end-to-end, but with the extremities overlapping laterally. The fin posterior to the vertebral axis is very similar to the posterior part of the ventral lobe but is more poorly preserved. In the

ventral lobe the place of the vertebral axis is taken by a series of radials, about fifteen in number. These are elongate but appear more narrow than they are, because each element is partly overlapped by the next in front. The length of these radials averages about 85 mm. The first three reach the anteroventral margin of the fin and therefore bear no rays. From the distal end of each of the remaining radials a single fin-ray arises. These rays are highly segmented, the segments being broader than long, especially

PLATE XLVI

Detail of caudal pedicle and base of caudal fin; approximately $\frac{1}{4}$ natural size.

in the anterior part of the fin. The first seven of these rays do not branch; each of the first four ends in a triangular segment that is longer than broad and resembles a fulcral scale, whereas the remaining three simply taper to slender points. On the eighth ray this point is obscurely bifid, and this marks the beginning of the dichotomous branching, which becomes highly developed posteriorly. This repeated branching gives rise in the posterior part of the ventral lobe to a broad, delicate sheet of flexible fin rays.

A similar sheet makes up the posterior part of the dorsal lobe. The posterior margin of the caudal fin, as preserved, is somewhat ragged, part of which condition appears to be the result of damage during life. The dorsal lobe being partly missing and the ventral lobe being incomplete at the extremity, no precise measurements can be given. It is estimated that the ventral lobe, from pedicle to tip, measured about 420 mm. and that the vertical interval from dorsal to ventral tip was about 740 mm.

The scales are mostly arranged in nearly vertical rows and are large and rectangular in shape. A typical scale in the dorsal region measures 85 mm. in the vertical direction and 25 mm. across. The line of juncture of two adjacent scales in a row is oblique, with the upper scale overlapping the lower posteriorly and the lower overlapping the upper anteriorly. These scale junctions do not alternate in adjacent rows but form continuous lines across the body, trending posteroventrally. The external surface of the scales is minutely sculptured in a multitude of tiny tubercles, so small as to be barely visible to the eye. In places these coalesce to form sinuous lines. In the posteroventral region, adjacent to the anal fin, the scales are much smaller and are only moderately elongate. They are arranged in rows trending posterodorsally, almost parallel to the anal margin, and the scales of one row alternate with those of the adjacent rows.

Comparison with the Type of *"Platysomus" canadensis*

The specimen found by Peyto and described by Lambe is much more extensively preserved than is that from the vicinity of Fernie. The former specimen shows almost the complete body, except for a part of the anteroventral region, and the skull, which is crushed but mostly preserved. The two specimens resemble each other in the following features: very large size; rhombic outlines; long dorsal and anal fins; caudal fin heterocercal but deeply and symmetrically bifurcate; scales elongate-rectangular, arranged in nearly vertical rows with an area of smaller reflected scales in the posteroventral region. Noticeable differences between the two specimens are: relatively broader caudal pedicle in the Fernie specimen; dimensions of Fernie specimen more than one and a half times that of Banff specimen. These differences do not appear to prohibit the inclusion of the new specimen from Fernie with the species *"Platysomus" canadensis.*

Relationships of *"Platysomus" canadensis*

It was stated above that various authorities are agreed in excluding *"Platysomus" canadensis* from the genus *Platysomus.* In size the Canadian specimens greatly exceed the limits of other known species of this genus. This, however, would not be sufficient to exclude *"P." canadensis,* and the discovery of *"Platysomus" brewsteri,* which is comparable in size with many species of *Platysomus,* further weakens the size characteristic as a basis for differentiation. Much more significant is the position of the pectoral fin, which is marginal in accepted species of *Platysomus,* but which is situated only a little below mid-height in *"Platysomus" canadensis.* In *Platysomus* there is a small but distinct pelvic fin; in *"Platysomus" canadensis* this is probably but not certainly absent. In *Platysomus* the angulations of the dorsal and ventral margins are almost in a vertical line, whereas in *"Platysomus" canadensis* the dorsal angulation is well in advance of the ventral.

Another genus with which the Canadian fish might be compared is *Ecrinesomus*, described by A. Smith Woodward (1910) from the Lower Triassic of Madagascar. Additional specimens of *Ecrinesomus dixoni* Woodward were subsequently described and illustrated by Priem (1924). Resemblances between "*Platysomus*" *canadensis* and *Ecrinesomus* are: deep body with vertical rows of scales; area of reflected scales in postero-ventral region; slender caudal pedicle; pectoral fin moderately large, situated high on the body; dorsal and anal fins long, each with anterior extension. Apart from the great difference in size, the major difference is seen in the outline, which is broadly ovoid in *Ecrinesomus*, without the dorsal and ventral angulations. One specimen figured by Priem (1924, Plate 4, fig. 1) plainly shows these angulations, but this particular specimen was referred by White (as quoted in Stensiö, 1932, p. 127) to his genus *Bobasatrania*.

The genus *Bobasatrania* White (1932), type species *B. mahavavica*, was also based on specimens from the Lower Triassic of Madagascar. Other species occur in the Lower Triassic of Spitsbergen (*B. nathorsti*) and Greenland (*B. groenlandica*) (See Stensiö, 1932). As described by White and more fully by Stensiö, this genus differs from *Ecrinesomus* mainly in the rhombic outline of the body, with prominent dorsal and ventral angulations. The pectoral fin is high, as in *Ecrinesomus*, but is unusually long. In both genera the pelvic fin is absent. The species of *Bobasatrania*, like that of *Ecrinesomus*, are much smaller in size than "*Platysomus*" *canadensis*. The body outline in the Canadian species is rhombic and angulate, as in *Bobasatrania*, but the pectoral fin is only moderately large, as in *Ecrinesomus*. Stensiö (1932, p. 126), discussing the status of "*Platysomus*" *canadensis*, concluded that because of the imperfection of the type specimen, "it must be left undecided whether it really belongs to *Bobasatrania* or whether it is representative of a new genus."

From a study of the new specimen from Fernie and from a survey of the literature, the writer is convinced that "*Platysomus*" *canadensis* and "*P.*" *brewsteri* represent an undescribed genus, characterized by medium to very large size, rhombic body outline, and a moderately large pectoral fin situated high on the flank. Unfortunately, none of the available specimens demonstrates the probable absence of the pelvic fins, and even the pectoral fins are not too well preserved. In view of these deficiencies in our knowledge the writer prefers to postpone formal definition of this new genus and proposes that the species from the Canadian Triassic be known provisionally as *Bobasatrania*? *canadensis* (Lambe) and *Bobasatrania*? *brewsteri* (Warren).

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COMPLETE SKELETON OF *LEPTOCERATOPS GRACILIS* BROWN from the UPPER EDMONTON MEMBER ON RED DEER RIVER, ALBERTA

By C. M. Sternberg

INTRODUCTION

In 1914 Barnum Brown established the genus and species *Leptoceratops gracilis* (2) on parts of a small ceratopsian that he had collected from the Edmonton formation on Red Deer River in Alberta. The type material consisted of parts of the skull, lower jaw, teeth, disarticulated dorsal vertebræ, almost complete articulated tail, a complete pectoral arch and fore limb, and other bones. He recognized *L. gracilis* as a primitive form.

In 1946 I secured evidence to show that Brown's type of *L. gracilis* and his *Ankylosaurus* skeleton, as well as the type of *Thescelosaurus edmontonensis* Sternberg, came from the Upper Edmonton member (16). I was not able to locate the quarry from which Brown collected the type of *L. gracilis*, but in 1947 I did locate and identify, from photographs taken by Brown, the quarry from which he collected *Ankylosaurus* near the centre of Sec. 26, tp. 33, rge. 22, W.of 4 mer., about 210 feet above Red Deer River and 15 feet above the base of the Upper Edmonton member. Brown's notes state that both *L. gracilis* and *Ankylosaurus* came from 190 feet above Red Deer River. His notes also state that *Leptoceratops* came from "clay above upper sand near top of beds." This description could fit only the Upper Edmonton member at this locality. It seems certain, therefore, that the genotype of *Leptoceratops* came from the Upper Edmonton member. The presence of *Triceratops* and *Ankylosaurus* in these beds shows that they are of Lance age.

The 1947 field season was spent on Red Deer River, collecting from the Upper Edmonton member, and toward the end of the season I located a skull and jaws and a considerable part of a splendidly preserved skeleton of *Leptoceratops gracilis* (Catalogue No. 8889). At the same time, student assistant T. P. Chamney located a smaller individual of the same species (No. 8888) which was complete except for most of the head and parts of the left fore foot, which had been eroded away. A number of well-preserved teeth were on the surface. While working on this specimen, a third and still smaller individual (No. 8887) was located, lying beside it. (It is believed that this is the only absolutely complete ceratopsian skeleton known.) Number 8887 has an overall length of 5 feet, 4 inches; No. 8888 is 6 feet, 7 inches (front of skull estimated); and No. 8889 is estimated to have been from 7 feet 8 inches to 8 feet long. The two skeletons came from directly over Campkin's coal mine, in the northeast corner of Sec. 12, tp. 36, rge. 22, W. of 4 mer., about 13½ miles northeast of Elnora, Alberta, 50 feet above the base of the Upper Edmonton member. Number 8889 was 5 feet higher in the beds and less than 50 years distant from the others. This locality is approximately 14 miles north of the locality from which Brown collected the type of *Leptoceratops gracilis*.

74811—16

All comparable parts check very closely with preserved parts of the type specimen and with each other, and it is believed that our three and Brown's two specimens all represent the same species. As our specimens represent three sizes, all of which are smaller than the type, and Brown's second specimen is still larger, we have five growth stages. The complete ossification of the bones shows that they were not extremely young, but the open sutures suggest that none represents an old animal. They probably represent half-grown or young adults, and it is possible that, in this form, the bones were not co-ossified as early in life as they were in more advanced forms. It is interesting to note that *Leptoceratops*, which is the most primitive known member of the Ceratopsia, is associated with *Triceratops*, which is the most advanced ceratopsian. One might hazard a guess that the upland was preferred by the primitive ceratopsians and that in *Leptoceratops* we have a primitive form that continued on with little change, except some increase in size. Perhaps the delta country was more conducive to rapid growth and evolution, but the smaller and more primitive forms usually remained on the upland and, therefore, were not so often preserved as fossils.

In 1923, Granger and Gregory described *Protoceratops andrewsi* from Mongolia and established the family Protoceratopsidæ (9). In 1925 Gregory and Mook described *Protoceratops* in more detail and referred *Leptoceratops* to the Protoceratopsidæ (10). Gregory and Mook drew attention to a number of similarities between *Protoceratops* and *Leptoceratops*, but they regarded *Leptoceratops* as more progressive in the following respects:

(1) Reduction of the parietal fontanelles;
(2) Coalescence of the anterior three cervical vertebræ;
(3) Backward prolongation of the spine of the axis above the third cervical vertebra;
(4) Shortening of the metacarpals and especially of the metatarsals.

The first three cervicals and the metatarsals were not preserved with the *Leptoceratops* material, so no comparison with them could be made, and the parietals were incomplete. It might be that they made their comparisons with a specimen from the St. Mary River formation of Montana that was later described by Brown and Schlaikjer as the type of *Leptoceratops cerorhynchus* (5) but, as I will attempt to show, this species belongs to a genus quite distinct from *Leptoceratops*. In almost every respect the Montana species is more advanced than *Protoceratops*, whereas *Leptoceratops* is the most primitive of all.

As both the genotype of *Leptoceratops* and the Montana specimen were incomplete, few parts could be directly compared. Also, it is difficult to make proper comparisons from the literature, because the given scale of several of Brown's illustrations of *L. gracilis* is incorrect.

Through the courtesy of Dr. E. H. Colbert, I examined the type of *Leptoceratops gracilis* and the parts of the second specimen collected with it and also the mounted skeleton that Brown and Schlaikjer described as *Leptoceratops cerorhynchus*. The bones of the type of *L. gracilis* are more massive than those of the Montana specimen, though the former is regarded by Brown and Schlaikjer as a young individual, and the latter as fully

adult. The dorsal vertebræ of the type of *L. gracilis* are about the same size as those of the Montana specimen, but the dorsals of the second specimen of *L. gracilis* are larger. The femur and tibia are somewhat larger in *L. gracilis*.

With the newly acquired skeletons of *L. gracilis*, we are now able to make direct comparisons with such parts of the type of *L. cerorhynchus* as are preserved. Unfortunately, very little of the skull is preserved with the Montana specimen, but the parts that are present are quite diagnostic. In "*L.*" *cerorhynchus* there is a well-developed nasal horncore, whereas in *L. gracilis* there is no evidence of a horncore or even arching of the nasals. Brown and Schlaikjer thought that concentration of the grain of the bone to the centre of the nasal foreshadowed a nasal horncore. This structure is not centred on the united nasals but rather on each nasal bone. Moreover, in our No. 8887, similar concentration of the grain of the bone is to be seen near the centre of the premaxillæ, nasals, maxillæ, jugals, postorbitals, and dentaries. It would appear, therefore, that the radiation of the grain of the bone had to do with the growth of the bone, rather than the foreshadowing of a horncore. In fact, the whole structure of the *cerorhynchus* nasal is distinctly different from that in *Leptoceratops*. The nasal opening was very different in shape and position. A still more important feature is seen in the squamosal, which in *cerorhynchus* is extended well behind the head of the quadrate to help form the parietosquamosal crest common to all Ceratopsia except *Leptoceratops*. In *Leptoceratops* the unfenestrated parietals overhang the occiput, but the squamosals are not produced backward to help form the crest but send a narrow hook down behind the head of the quadrate. This region more nearly resembles that seen in the Hadrosauridæ than in any advanced ceratopsian. The other diagnostic part of the head, known in the Montana specimen, is the dentary. In this the ventral border is straight, and the whole dentary is relatively long. In *Leptoceratops* the dentary is short, and the ventral border is rounded. The very long neural spines on the caudals of *cerorhynchus* are more like those of *Protoceratops* than the medium-length spines of *L. gracilis*.

Brown and Schlaikjer (5) point out many features in which *Leptoceratops* is more advanced than *Protoceratops*, but most of their observations are made on referred specimens from very different horizons and localities. As will be shown later, the whole skeleton of *Leptoceratops gracilis* is more primitive than that of either *Protoceratops* or the Montana specimen, but the above-mentioned skull differences are, in themselves, sufficient to show that the type of *cerorhynchus* does not belong to the genus *Leptoceratops* and, therefore, is without generic name. For the reception of the species I would propose the generic name *Montanoceratops*.[1]

Brown and Schlaikjer also compared their specimen with material (two individuals) that Gilmore had collected from the Two Medicine formation of Montana and referred to *Leptoceratops*, but without specific designation (8). The nasals and the distal half of the femur and of the tibia and fibula are the only parts in Gilmore's material that are preserved in the other specimens. The nasals are quite distinct in each case. In Gilmore's specimen the premaxilla contains roots of two teeth, as in

[1] I wrote to Dr. Schlaikjer, pointing out the great differences in the two species and suggested that he propose a new generic name for *cerorhynchus*, but no action has been taken.

Protoceratops. Also the frontals somewhat resemble those of *Protoceratops*, but are very unlike those of *Leptoceratops*. The pes is more slender than it is in *Leptoceratops*, and the metatarsals are longer when compared with the length of the tibia. Through the kindness of Dr. D. H. Dunkle, I had the opportunity of examining Gilmore's material and comparing it with our newly acquired *Leptoceratops gracilis* specimens. All parts of Gilmore's specimens are different from those of *L. gracilis*, and it is quite evident that the Two Medicine specimens do not belong to the genus *Leptoceratops*.

DESCRIPTION

Order, **Ornithischia**
Suborder, CERATOPSIA
Family, **Protoceratopsidae**

Leptoceratops gracilis Brown

Plesiotype, No. 8887, Nat. Mus., Canada, consists of complete skeleton, articulated.

Plesiotype, No. 8888, N.M.C., consists of skeleton, complete except most of skull and jaws and part of front foot.

Plesiotype, No. 8889, N.M.C., consists of skull and jaws, presacral vertebræ, ribs, pectoral arches except upper ends of scapulæ, left fore and hind limbs, sternal and hyoid bones.

Horizon, for all three, 50 to 55 feet above base of Upper Edmonton member (uppermost Cretaceous).

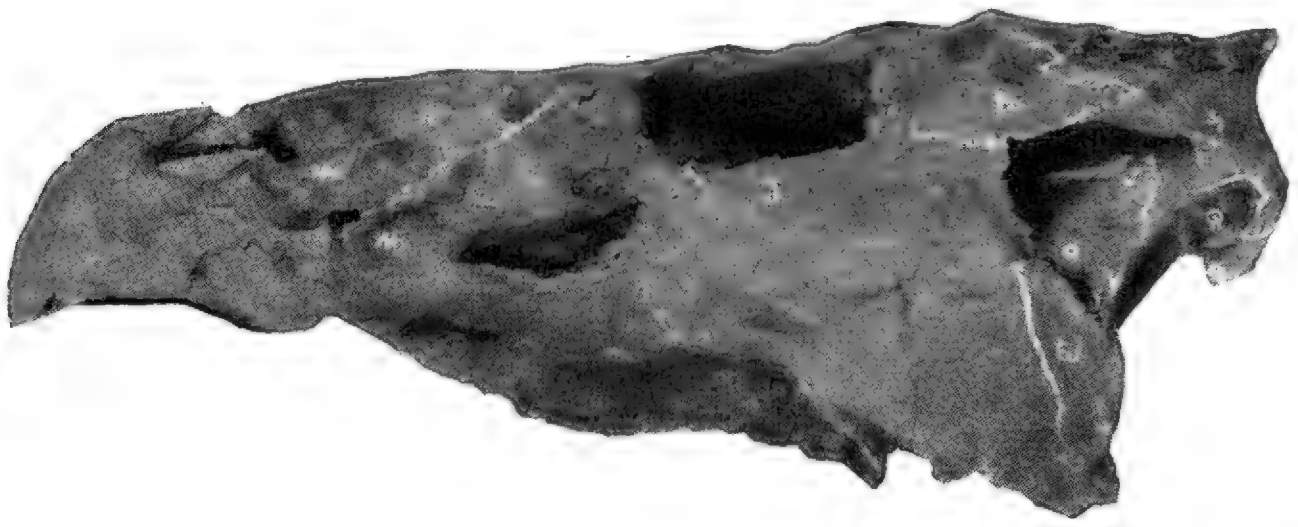
Locality, for all three, northeast corner of Sec. 12, tp. 36, rge. 22, W. of 4th mer., about 13½ miles northeast of Elnora, Alberta.

Family Characters (emended). Primitive small ceratopsians; skull hornless, with or without parietosquamosal crest; no secondary roof formed by folding of frontals; no epoccipitals; simple oval anterior nares; unspecialized premaxillæ, with or without teeth; orbits large; freely articulating palpebral bones (supraorbitals) in anterosuperior corner of orbits; cheek teeth arranged in vertical series, not more than two developed at one time, roots not bifid; mandible short, deep, rounded below; manus smaller and much shorter than pes, latter elongate, with elongated unguals varying in breadth; ilium with blade erect or slightly inclined outward to the sagittal plane, not produced laterally above femur; prepubic process small; femur shorter than tibia and with fourth trochanter; midcaudal vertebræ with moderately long or long neural spines.

Generic and specific characters (emended). Face long and moderately low; no parietosquamosal crest; parietals extended and overhanging occiput, but not fenestrated, high thin sagittal ridge; exoccipital long, underlying parietal, bracing proximal end of quadrate; supratemporal fossa very large, not covered by postorbital and squamosal; lateral temporal fossa large and high; squamosal short, hooking behind head of quadrate, as in the Hadrosauridæ, but not extended backward to help form a crest or cape; squamosal-postorbital bar vertical and relatively narrow, anteroinferior tip meets posterior tip of jugal, barely excluding postorbital from boundary of lateral temporal fossa; quadrate almost vertical in lower half, superior half bent backward; jugal large and with large, vertically elongated epijugal; head broadest through jugals; maxillary sinus large and deep,

bounded by maxilla and lachrymal; nasals long, thin, broad posteriorly, and pointed anteriorly, no horncore; premaxillæ low and toothless; rostral of moderate size, superoposterior tip between premaxillæ and reaching to opposite anterior tip of nasals; palate narrow and high; maxilla large and overhanging the teeth, tooth row near centre of skull at front but gradually splaying posteriorly; teeth in maxilla and in dentary number 17 or more in adult; mandible short, heavy; predentary long and broad, superior surface gently concave and edges narrowly rounded, underlapping dentaries, but not wedged in between them; dentary short, high, rounded inferiorly and strongly upturned anteriorly, teeth well in from external surface, coronoid process low and set well out; coronoid large; splenial very large and reaching symphisis; 22 presacral vertebræ, first three separate in young but coalesced in adult; no neural spine on atlas, spine on axis large, spine on third slender and erect, not fused with axis spine; single-headed rib on atlas and No. 22, double-headed ribs on all others; sacrals not fused, or only first three fused in immature individuals; neural spines on

PLATE XLVII



Leptoceratops gracilis Brown. Plesiotype No. 8889, N.M.C. Skull, left side view. $\times\frac{1}{4}$. (Neg. No. 103487)

caudals of moderate length; ribs very slender; clavicles small but well ossified; ilium erect, blade thin and narrow, superior edge not everted; prepubis small, postpubis rather long; fore limb moderately large, but manus short and small; humerus with well-developed radial crest; femur shorter than tibia; pes long, unguals elongate.

As all known specimens of *Leptoceratops* appear to belong to the species *gracilis*, it is not feasible to attempt to state which of the above-mentioned characters are generic or specific.

The most surprising feature of the *Leptoceratops* skull is the lack of a parietosquamosal crest which is so characteristic of the Ceratopsia. Even in the youngest specimens of *Protoceratops* there is a well-developed parietosquamosal crest, and the parietals are fenestrated. It has been assumed that the crest was formed by the backward development of two branches of the parietal which surrounded the fenestra and which was flanked by the extended squamosal, which in some cases formed part of the border of the fenestra. We now see a more primitive beginning of the crest in which the squamosals have not been extended, and the expanded

parietals are not fenestrated. This appears to show that the fenestration of the parietals was secondary, and the very large fenestra in the long-crested *Chasmosaurus-Torosaurus* group was not a primitive character. It would also seem to prove, as has been generally accepted, that the primary expansion of the parietals, with the high sagittal crest, was for the added area of attachment for the powerful lower-jaw muscles. In the development of the quadrate, the squamosal, the narrow postorbitosquamosal bar, the parietals, and the large supratemporal fossa, *Leptoceratops* more nearly resembles the Hadrosauridæ than later ceratopsians. The lack of teeth in the premaxillæ may not be a primitive character, for one would not think that they would be developed in *Protoceratops* and then so soon lost. It seems more likely that the presence of premaxillary teeth was a primitive character that was not retained in *Leptoceratops*.

PRIMITIVE CHARACTERS

Leptoceratops is quite the most primitive ceratopsian yet reported. In the following characters it is more primitive than *Protoceratops*: face elongate and low; external nares horizontally placed; nasals broad and not arched; frontals large, relatively flat, smooth, not depressed posteriorly, no evidence of frontal folding, contact with parietals broad and straight; parietals overhanging occiput, but relatively short, narrow, not fenestrated, and not upturned posteriorly, high, thin sagittal ridge; squamosal not produced behind quadrate, except for a hook-like process which extends down behind head of quadrate and separates it from external tip of exoccipital, forms more than half of external border of large supratemporal fossa but does not cover it, barely in contact with posterior tip of jugal; anterosuperior part of postorbital angular, but posterior part thin and high, just barely excluded from border of lateral temporal fossa by tip of jugal; prefrontals widely separated by broad nasals and frontals; lachrymal large, forming most of anterior border of orbit; maxillary sinus very deep; mandible short, broadly splayed posteriorly; predentary broad, shallow, underlying upturned tips of dentaries, but not wedged in between them; dentary short, thick, teeth well in from external surface, coronoid process well out from tooth row; first three cervicals not fused except in older animals; no neural spine on atlas, vertebra No. 22 with free, single-headed rib and not fused with sacrals, sacrals free or partly fused, neural spines on caudals moderately long; blade of ilium erect, superior edge not everted.

The skull characters are taken mostly from our largest specimen, No. 8889, but the characters of the skeleton are taken from all three of our specimens and the type.

SKULL

In general the skull resembles that of *Protoceratops*, but the face is lower and longer, and there is no parietosquamosal crest. In the very young *Protoceratops* the face was lower than in the older individuals, but this does not appear to be so in *Leptoceratops*. Compare Plates XLVII and XLIX.

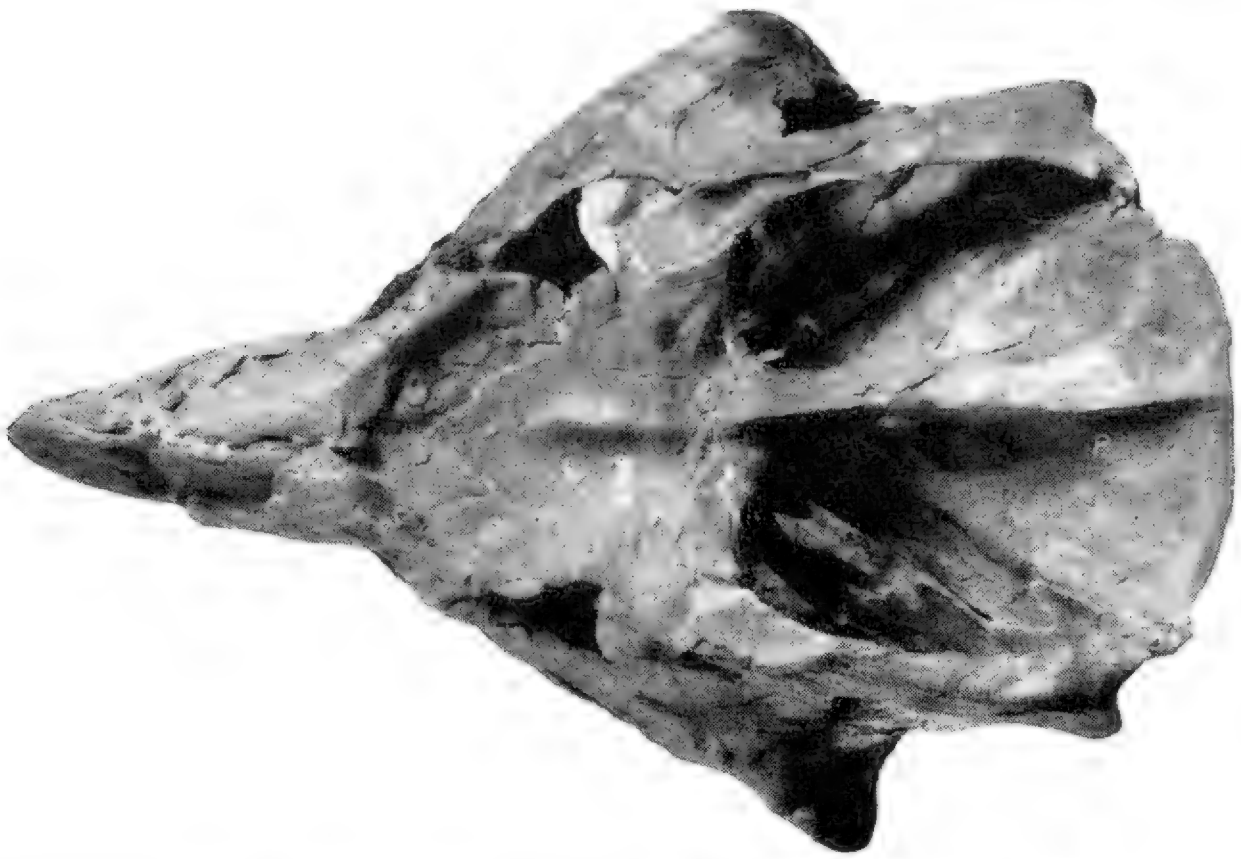
The rostral resembles that of the young *Protoceratops* but is less hooked than in the older individuals.

The premaxilla is somewhat lower than in *Protoceratops*, the inferior border in front of the maxilla is strongly convex, and there are no teeth

in this bone. It is very different from the modified premaxilla of the advanced ceratopsians. The posterior process overlaps the nasal and maxilla above midheight of the nose. The external naris is bounded by the premaxilla and nasal, and is more horizontally placed than in *Protoceratops*.

The nasal is long, broad posteriorly, and smooth except for the radiation of the bone structure mentioned above, and there is no evidence of upgrowth to form a horncore. The anterior tip flanks the posterosuperior tip of the premaxilla to the anterior border of the external naris. Posteriorly the tip of the united frontals is wedged in between the posterior tips of the nasals. From the tip of the frontals opposite the middle of the maxillary sinus, the nasal is produced back and out, and the blunt tip is wedged between the frontal and prefrontal, about opposite the anterior corner of the orbit.

PLATE XLVIII



Leptoceratops gracilis Brown. Plesiotype No. 8889, N.M.C. Superior view of skull. ×¼.
(Neg. No. 103482)

The maxilla is relatively very large, deep, and short in No. 8887, but relatively longer in No. 8889. It reaches well up the side of the face and is in contact with the nasal in front of the lachrymal. The nasal-maxillary contact is partly overlapped by a thin process of the premaxilla. The tooth row is well in from the external surface, and the maxillary ridge overhangs the teeth and flares out to meet the large jugal. From its posterior half, just in advance of the overlapping ectoptergoid, the superior part of the maxilla extends out, as a broad shelf, to the maxillary ridge. This is behind the maxillary sinus. This shelf appears to occupy the position of the enlarged ectoptergoid in *Protoceratops* (4, pp. 187-8), but in our specimen it is definitely maxilla. The overhang is especially noticeable in the larger skull. Lull (11, p. 21) and Russell (13, p. 40) believe that the maxillary ridge supported a sheet muscle, labelled buccinator muscle, which served as a cheek pouch. Brown and Schlaikjer (4, p. 144) contend

that this muscle was not present in reptiles. It must be remembered that in no living reptile is the structure and arrangement of the jaws and teeth so well adapted for shredding large quantities of vegetation. Without entering into the discussion as to what muscles were present in the Ceratopsia, I would say that I fully agree with Lull and Russell that there was a cheek pouch and that the gape was relatively short. The narrow ridge on the dentary, which is a continuation forward of the coronoid process and well out from the tooth row, is opposite the maxillary ridge. The maxillary sinus is very large and deep. It corresponds, in size and position, to that of *Protoceratops* but is much deeper. In the upper part of the posterior half of the sinus there is a rather large oval foramen piercing the floor of the sinus. This is mainly within the maxilla but is bounded superiorly by the lachrymal. This foramen probably represents the antorbital fossa of later ceratopsians. The sinus was already becoming shallow in *Protoceratops.* The right and left maxillæ meet in the roof of the mouth for a very short distance at their anterior tips, just back of the premaxillary contact.

The lachrymal is large, and it forms the anterior edge of the orbit and the superior edge of the maxillary sinus. Much of its superior edge is in contact with the prefrontal, but anterosuperiorly it meets the nasal. There is no sign of a lachrymal foramen.

The prefrontal is roughly elongate, oval in outline, but broader and heavier in front. It lies between the lachrymal and posterior branch of the nasal anteriorly, but posteriorly it flanks the frontal and forms nearly half of the orbital rim.

The palpebral bone lies loose in the superoanterior border of the orbit, but there is no sign of a depression in the prefrontal for its reception.

The frontals are thoroughly fused in No. 8889. (In No. 8887 the suture between the two frontals is open.) They are long, pointed anteriorly, but broad posteriorly. They form about one third of the superior border of the orbits, and posteriorly they splay out to meet the lateral wings of the parietals and form the anterior border of the supratemporal fossa. The posterior tip is flanked by the anterior half of the postorbital. Their greatest length in No. 8889, on the midline, is 110 mm., the combined breadth at the orbits is 120 mm., and the extreme posterior breadth is 150 mm. The dorsal surface is slightly dished laterally, and smooth. There is no evidence of the beginning of frontal folding.

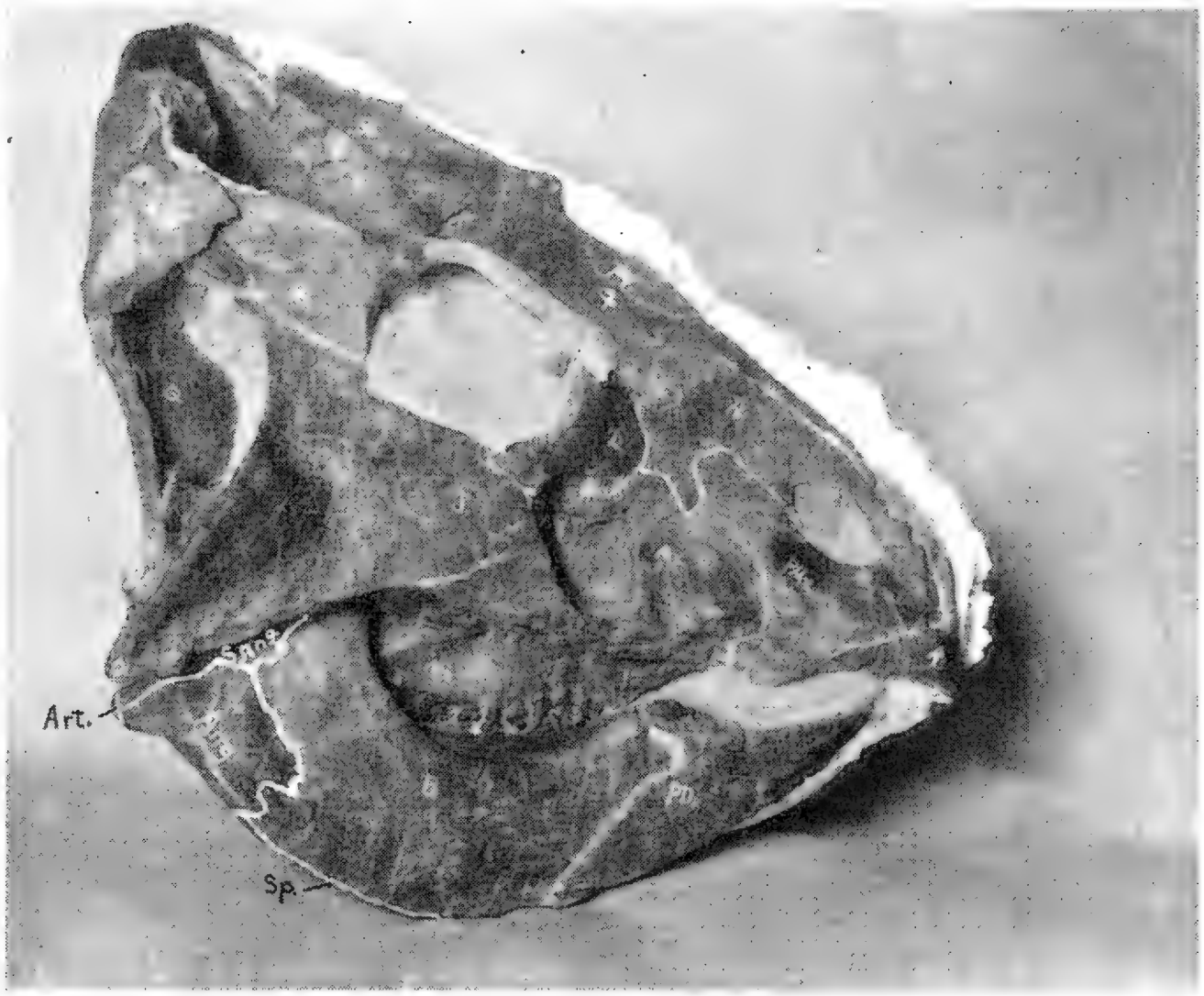
In speaking of the secondary skull roof, Brown and Schlaikjer state that "Definite evidence of how and of what this secondary roof is formed has never been presented" (4, p. 158). In 1927 it was pointed out that the secondary roof in the Ceratopsia was composed of the folded frontals (14). In older individuals of *Protoceratops* the posterior half of the frontals are rather sharply depressed, and Brown and Schlaikjer believe that this represents the beginning of the folding of the frontals. This depression is transverse and is behind the orbits; whereas, in *Brachyceratops montanensis,* (7, Figure 3), which apparently is a juvenile *Monoclonius,* the depression is along the midline and is between the orbits. In the young adult *Monoclonius lowei* (15, Figure 1) and in *Styracosaurus* (14, Plate XLVII), the frontals meet on the floor of the elongated frontal fontanelle which is between the orbits. The posterior depression of the frontals probably does represent the initial stage of the folding, but it is much less advanced and quite different from that seen in *Brachyceratops* and other advanced forms.

The parietals resemble those of the young *Protoceratops*, but they are not so much extended and are not fenestrated. They are thoroughly fused in all known specimens. The lateral wings, for contact with the frontals, extend to the outer edge of the supratemporal fossæ. Just back of these wings the parietals are narrow and high where they overlie the posterior part of the brain. They cover considerably more of the brain than they do in advanced forms. The narrow part of the parietals extend back, about 50 mm., to even with the foramen magnum. From this point they splay rapidly and extend up and back for about 115 mm., forming a gently arched, overhanging occiput. The anterior part of the splaying parietals is considerably below the frontals. On the midline the top of the parietals, except the high sagittal crest, is slightly below the level of the frontals anteriorly, but this gradually rises as it proceeds backward, and the broad, slightly convex posterior border is about on a plane with the frontals. The narrow sagittal ridge stands well above the frontals anteriorly, but posteriorly it blends in with the superior surface. Due to the fact that the parietals are below the level of the frontals anteriorly, the sagittal ridge is much higher in front. All of the expanded parietals are very thin but not fenestrated. The posterior edge extends only slightly behind the proximal end of the quadrate and is thin and smooth. The posteroexternal edge of the parietal meets the inturned flange of the squamosal, and inferiorly it is supported by a long, narrow wing of the exoccipital.

The supratemporal fossa is large and oval, but because of splaying of the parietal below the surface, it narrows posteriorly. It opens directly above the posterior part of the maxilla and the coronoid process and is not deflected or covered by the postorbital or squamosal.

The squamosal (Plate XLVII, Sq.) more nearly resembles that of the hadrosaurs than any of the advanced ceratopsians. Its rather high, thin anterior branch overlaps internally the posterior branch of the postorbital and forms more than half of the external boundary of the supratemporal fossa. Posterointernally it sends a short, high, thin flange inward to bound the external posterior corner of the fossa and unite with the parietal. It sends a long, narrow tongue of bone down on the front surface of the proximal end of the quadrate and a rather small hook-like process down behind the head of the quadrate. This is, in turn, supported by the end of a long, narrow branch of the exoccipital. The anterior tongue of bone is much longer in the larger specimen, but it does not form the boundary of the lateral temporal fossa.

The quadrate resembles that of the young *Protoceratops* but is much more slender and relatively longer than in the advanced forms. In the smallest specimen, No. 8887, it is very slender and almost erect, but in No. 8889 the superior part is strongly arched backward. In its lower half, the external surface is produced slightly forward as a thin, narrow flange for articulation with the quadratojugal. The internal edge of the quadrate sends a very large, thin flange inward and forward to overlap the broad posteroexternal branch of the pterygoid. This flange extends inward and forward for 90 mm., and the tip reaches to even with the tooth row. Though the quadrate is rather slender in its main shaft, it is very well braced by this flange, and the quadratojugal is strongly supported proximally by the squamosal and braced by the exoccipital.



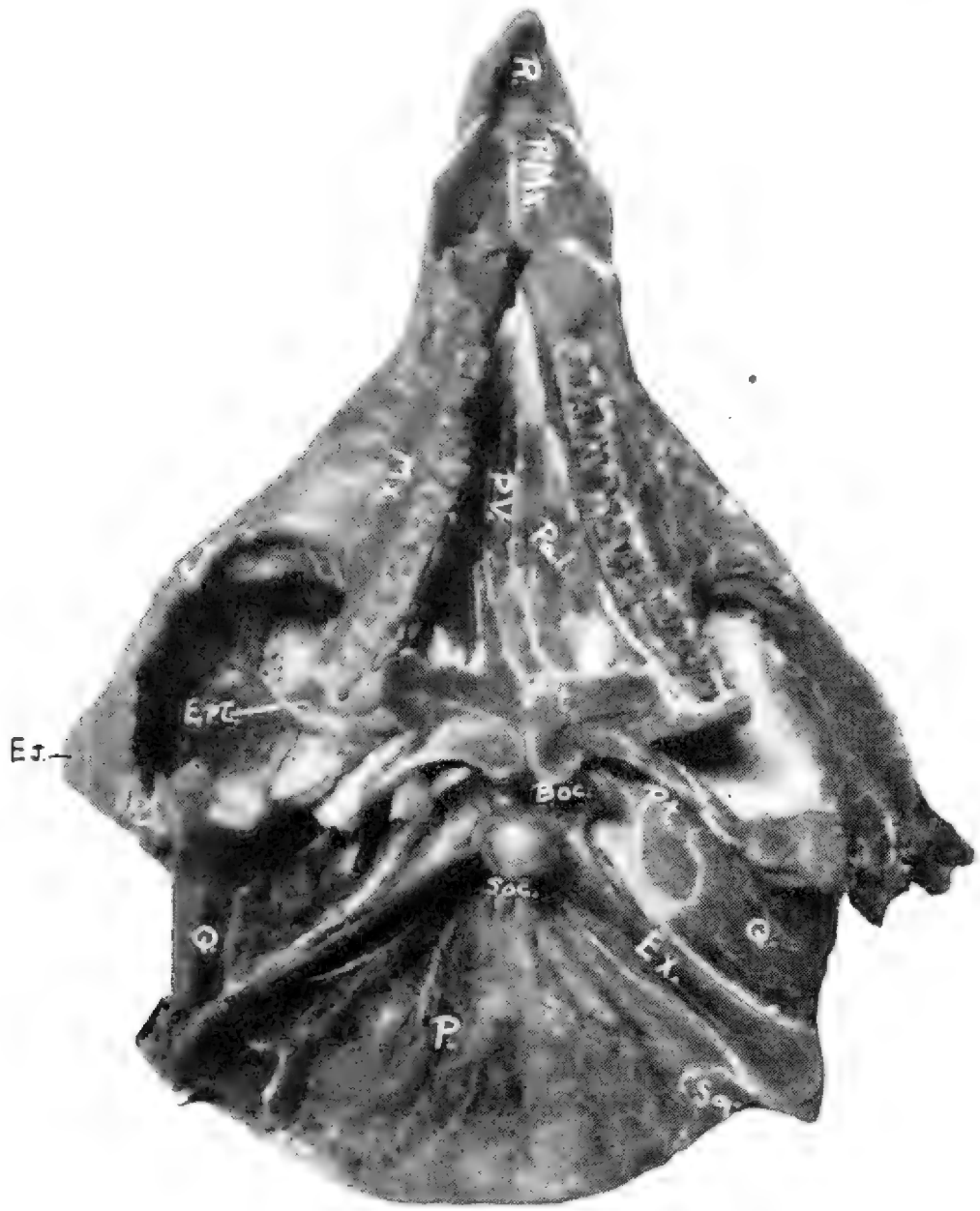
Leptoceratops gracilis Brown. Plesiotype No. 8887 N.M.C. Skull, right side view. $\times\frac{1}{4}$. Ang. Angular, Art. articular, D. dentary, F. frontal, J. jugal, L. lachrymal, Mx. maxilla, N. nasal, P. parietal, Pd. predentary, Pf. prefrontal, Pmx. Premaxilla, Po., postorbital, Q. quadrate, Qj. quadratojugal, R. rostral, Sp. splenial, Sq. squamosal, Sang. surangular. (Neg. No. 103488).

The quadratojugal is relatively large and most nearly resembles that of *Protoceratops*. In its lower two-thirds it is very thick and broad posteriorly and holds the jugal well away from the quadrate. The posteroventral tip extends below the tip of the jugal and reaches to the articular surface of the quadrate. About two-thirds of the way up, the bone narrows rapidly, but the inner edge continues up and forward to form a large but thin flange that extends forward on the inner face of the jugal. It completely separates the jugal and quadrate and is separated in No. 8889 from the extreme inferior tip of the squamosal by the quadrate. Where the posterior edge suddenly narrows, the heavy posterior edge of the jugal turns sharply inward to flank the thin inner extension of the quadratojugal. The combination of the posterior edge of the quadrate and the broad quadratojugal flanked by the heavy jugal gives a heavy, well-supported buttress for articulation with the heavy lower jaw. When viewed from behind, this mass presents a broad surface.

The jugal is more nearly horizontal than in other ceratopsians, except the young *Protoceratops*. It forms most of the lower boundary of the orbit.

It and the maxilla are the largest bones of the skull. It is broad throughout its whole length, and posteriorly it arches out strongly, especially in the largest skull. Near the posterior edge it supports a vertically placed epijugal, and at this point the skull is broadest. From the posteroexternal edge, the jugal turns inwardly at almost right angles to meet the quadratojugal. In the smallest skull the jugals are not splayed so much, and the exoccipital is not so large, but even here, the greatest breadth of the skull is through the posterior angles of the jugals.

PLATE L



Leptoceratops gracilis Brown. Plesiotype No. 8889, N.M.C. Skull, inferior view. $\times\frac{1}{4}$. Boc. basioccipital, Ej. epijugal, Ept. ectopterygoid, Ex. exoccipital, Pal. palatine, Pt. pterygoid, Pv. prevomer, Soc. superoccipital. (Neg. No. 101622)

The exoccipitals resemble those of *Protoceratops*, but the posterolateral extensions are much longer and more slender than in the advanced ceratopsians. In the small skull, No. 8887, they are of moderate length and extend almost directly outward, but in No. 8889 they are much longer and extend outward and backward to support the backwardly directed head of the quadrates and reach the extreme posterior edge of the squamosals. As in *Protoceratops*, the distal end is rounded and the superior half fits in a shallow

groove on the internal edge, but unlike in that genus, the squamosal is not produced behind the end of the exoccipital. Except for the superior part of the rounded distal end which is overlapped by the squamosal, the whole of the superior edge is overlapped by the extended parietals.

In the small skull the exoccipitals meet, inferiorly, to exclude the basioccipital from the foramen magnum, but they do not enter into the formation of the occipital condyle. In the somewhat larger specimen, No. 8888, the foramen magnum and condyle are preserved, and here the sutures are open and show the exoccipitals forming the upper rim of the condyle. In No. 8889, the sutures between the basioccipital and the exoccipitals are thoroughly fused, but the exoccipitals appear to form about one third or less of the upper part of the condyle. In the Ceratopsidæ the basioccipital and supraoccipitals contribute about equally to the formation of the condyle.

The occipital condyle resembles that of the Ceratopsidæ, but the "neck" is shorter and less distinct. It is hemispherical and points backward and slightly downward, as in most members of the suborder.

The supraoccipital is relatively larger than in any other ceratopsian and forms the upper boundary of the foramen magnum and covers the narrow posterosuperior part of the brain. In all other ceratopsians, except *Protoceratops*, the supraoccipital appears to have been eliminated from the boundary of the foramen magnum by the exoccipitals. In the largest specimen, No. 8889, the supraoccipital and exoccipitals are thoroughly co-ossified, but in No. 8888 the sutures between these bones can be traced. In No. 8887, the bone is cracked in this region, so the supraoccipital can not be traced. It is not so broad as shown by Brown and Schlaikjer in *Protoceratops*. The perpendicular face, above the foramen magnum, is composed of supraoccipital. See Plate L, Soc. The foramen magnum is round in No. 8889, but ovoid, with the superior part high and narrow, in 8888.

The pterygoid of No. 8889 is complete and well shown, Plate L, Pt. It resembles that of *Protoceratops*, but there is a well-pronounced, bluntly pointed wing extending backward and downward under the basioccipital buttress. As in that genus, the posterolateral wing is broad, forked, and thin, and it laps the large, thin flange of the quadrate but does not fit into a notch in that bone. The lateroventral wing is long and slender. It embraces the posterior part of maxilla, is in contact with the posterointernal edge of the ectopterygoid, and sends a long, slender point below and behind the posterior tip of the ectopterygoid. The anterosuperior branches are long and pointed. The elongated tips embrace the posterior fourth of the long, slender prevomers and are in turn embraced by the posterior half of the superior border of the palatines.

The ectopterygoid is broad and thin in its anterior half but with the posterior half of the external edge greatly thickened. It overlies the posterior part of the maxilla and posterolaterally sends a narrow thick extension back beyond the end of the maxilla. It is exposed on the palate for a short distance behind its anterior contact with the maxilla. Behind this free border its internal edge meets the pterygoid and continues backward for about 20 mm., then turns rather sharply outward, giving a broadly rounded posterointernal edge, and meets the thickened external projection where it turns sharply backward.

The palatine, Plate L, Pal., is a large, thin plate of bone which is longer than in *Protoceratops* due, partly at least, to the fact that the face is considerably longer in *Leptoceratops*. It is much longer and more nearly parallel with the axis of the skull than in the more advanced ceratopsians. It is in contact with the prefrontal and lachrymals and has a more extensive contact with the maxilla than in *Protoceratops* but does not quite meet the ectopterygoid. Posteriorly, it is in contact with the pterygoid, and almost half of its superior border flanks the anterosuperior tip of the pterygoid. Anterior to the tip of this bone, it flanks the prevomer. Inferiorly, it is in contact with the maxilla, except for a rather extensive excavation in its lower border near the front, thus giving a rather large fossa between the palatine and the maxilla. Posteriorly there is an opening, bounded by the palatine, pterygoid, ectopterygoid and maxilla. The anterior tip unites with the maxilla for only a short distance in advance of the above-mentioned fossa. This anterior tip forms the posterior border of the internal naris which is bounded externally and anteriorly by the maxilla, and internally by the prevomer. The internal naris is smaller than in *Protoceratops*, and much smaller and farther forward than in the advanced ceratopsians.

The prevomers are very long, slender bones, wedged in between the maxillæ anteriorly and between the palatines and pterygoids posteriorly. Only the anterior one-third of the bones divide the relatively short internal naris.

MANDIBLE

The mandible of the largest individual, No. 8889, is splendidly preserved, and most of the description will be based on this specimen. The mandible of the smallest specimen, No. 8887, is complete but articulated with the skull so that details of the bones on the inside of the jaws are not available.

The predentary is long, broad, and shallow. The anterior part, or that part that supported the cutting beak, is relatively shorter than in any advanced ceratopsian, being less than half the total length. This is concave above, the sides are gently sloping, and the superior edges are rounded posteriorly, but gradually sharpen as they proceed forward and have a knife-like edge at the tip. The inferior surface is convex with a broadly rounded keel, which continues almost to the lower end. The posteroinferior surface is slightly concave superiorly and underlaps the long, upturned anterior end of the dentaries. The posterior end is divided into two thin, blunt tips, and the lower end of the symphysis and the tips of the splenials are exposed between these tips. The superoposterior edge is suturely united with, and slightly overlaps, the blunt anterosuperior tip of the dentary, making a strong union.

The dentary is short and heavy. In general it resembles that of *Protoceratops* but is more massive and more sharply upturned in front. The superior surface is broad and flat, and the shallow tooth magazine is well removed from the external surface and overhangs the internal surface of the lower half. This broad, flat superior surface is slightly higher than the grinding surface of the teeth. The coronoid process rises from the posterosuperior angle of the bone and is well out from the tooth magazine and overhangs, externally, the lower part of the bone. The process is relatively narrow, as in *Protoceratops*, and strongly striated for muscle attachment. From its base, the process bends slightly inward. The

anterior edge of the process runs forward as a rather sharp ridge at first, but gradually flattens out and disappears at the base of the upturned anterior end of the maxilla. The flat superior surface of the dentary, between the base of the ridge from the coronoid process and the alveoli, is 30 mm. broad in its posterior half and slightly less anteriorly. The inferior half of the dentary is quite narrow and is overhung, both internally and externally, by its broad superior part. See Plate LI.

PLATE LI

Leptoceratops gracilis Brown. Plesiotype No. 8889, N.M.C. Lower mandible, superior view. $\times\frac{1}{4}$. (Neg. No. 103484)

The dentary is strongly upturned in front, and the anterior edge measures 100 mm. The lower half of this meets its fellow and forms the symphysis, whereas the upper part is supported by the predentary only. The tips of the splenials take part in the formation of the symphysis. If the disarticulated mandibular ramus is viewed from the back, the upturned tip of the dentary appears to bend strongly outward, but, in reality, it is facing forward, and the jaw is splaying rapidly to meet the very broadly-spread quadrates. The distance from centre to centre of the quadrates is 205 mm., whereas, the total length of the mandible, less the predentary,

is 265 mm. Moreover, the articular is considerably nearer the midline than is the external edge of the maxilla. The anterior upturned edge is quite thin, especially above the symphysis, and the anteroexternal surface is covered by the predentary for about 25 mm. The superior face is also upturned anteriorly, and the truncated anterosuperior tip is 20 by 35 mm. and deeply pitted for the reception of a tip of the premaxilla. Teeth reach to within 20 mm. of the tip.

The angular is similar to that of *Protoceratops* but is slightly heavier in front and has a stronger articulation with the lower edge of the dentary. The inferior edge is a gently rounded, heavy ridge that unites with the posteroinferior angle of the dentary in a strong toothed suture. Above this toothed connection the angular sends a narrow tongue to overlap the dentary. The lower edge of the angular is fully as heavy as the lower edge of the dentary. Posteriorly, the ventral surface flattens and spreads as a broad, thin extension to underlap the anterointernal edge of the articular and the articular part of the surangular. The posterosuperior edge overlaps the surangular and the anterosuperior edge, the dentary. The angular forms only a small part of the inferior border of the mandibular fossa.

The surangular is a very large and important element in the structure of the articular area of the jaw. It is wedged in between the angular, articular, and dentary. Posteriorly it embraces the articular and forms part of the area of articulation with the quadrate and anteriorly sends a very broad, heavy process up behind, and to the top of, the coronoid process. Internally it forms most of the lateral and posterior border of the mandibular fossa and almost completely eliminates the angular from its boundary. Near its midlength it sends a short but strong process inward to embrace the anterior edge of the articular and unite with the prearticular. Posterolaterally, there is a prominent, somewhat rugose ridge which extends horizontally for 40 mm. Posterior to this ridge, the rather thick edge turns downward, inward, and backward to support the articular, but it does not extend under or behind it.

The articular is a rather heavy, elongate bone wedged in between the angular, surangular, prearticular, and posterior tip of the splenial. It makes up the greater part of the cotylus for articulation with the quadrate, and its superior surface is moulded to fit the distal end of that bone. However, the external edge of the cotylus is formed by the surangular. The superior, or exposed, surface is roughly ovoid, but anteriorly it sends a heavy, blunt projection forward and downward. This is almost completely embraced, superiorly and externally, by the surangular, but the blunt anterior end is exposed between this bone and the prearticular. In the posterior half of the superior face there is a pit surrounded by a low ridge. Anterior to this, a low longitudinal ridge divides the superior face, on either side of which the bone is slightly cupped to conform to the condyles of the quadrate. I see no evidence of lateral movement of the jaw, as described by Brown and Schlaikjer in *Protoceratops* (4, page 203).

The prearticular is a small, thin bone that stands erect and extends along the internal surface of the splenial, between the articular and the dentary. It is the second smallest bone in the jaw.

The coronoid is a fan-shaped bone of medium thickness that is closely applied to the inner face of the coronoid process of the dentary and the

upturned projection of the surangular. The superior edge is even with the tops of the surangular and coronoid process. The anterior edge extends slightly ahead of the edge of the coronoid process, and the posterior edge laps the surangular almost to the back of its superior edge. The whole of the broadly rounded edge is coarsely striated as are, also, the coronoid process and the inner face of the top of the surangular. Inferiorly the edges converge rapidly, and the inferior tip lies on the posterosuperior border of the maxilla and reaches nearly to the internal edge of the broad, superior surface.

The intercoronoid is a very small, rod-like bone that extends from the tip of the coronoid back around the posterior end of the tooth magazine and then forward along the superior edge of the splenial for a distance of 24 mm. This is quite the smallest bone in the jaw.

The splenial is a very large bone that covers the whole of the inferointernal border of the maxilla, laps the internal border of the angular, and barely reaches the articular. The anterior one-third is rather heavy and triangular in outline, but posterior to this it flattens, and the thin superior edge rises rapidly and covers the inner face of the maxilla almost to the teeth. Behind the teeth, it flanks the thin prearticular and ends in a point between the prearticular and angular. The anterior end is broad and shallow, thus standing well away from the dentary and meeting its fellow to form part of the symphysis. Proceeding backward, the base broadens and the ridge lessens and about one-third of the way back, merges into the broad, flat surface of the bone.

TEETH

The teeth have been well illustrated in Brown's description of the type (2, figures 2 and 6), but the dentary teeth of No. 8889 show a type of wear that differs from that seen in other ceratopsians. The dental magazine occupies practically the whole of the extreme internal edge of the dentary and overhangs the internal face of the lower part of the jaw. The magazine is shallower than in *Protoceratops* and much shallower than any advanced ceratopsian. There are seventeen vertical rows in both maxilla and dentary, but never more than two teeth in a vertical row. The smaller specimen has fewer vertical rows. The lingual-buccal diameter of the teeth is greater than their anteroposterior diameter. The cutting edge stands only slightly above the broad superior face of the dentary.

Due to the shape of the jaw and the breadth of the teeth, the lower jaw cannot go up past the maxilla and give a long shearing face on the teeth, but rather the dentary teeth are notched; and while the inner face (enamelled) forms a cutting edge, the tooth is worn down only part way, and the base of the broad fang forms a shelf to stop the upper teeth. Thus *Leptoceratops* could not only shred but could actually crush his food. This crushing shelf, or notch, is slightly below the superior surface of the dentary. The broad superior surface of the dentary must have formed the floor of a large cheek pouch. The anterior and posterior faces of the fang are smooth. Thus, the teeth are less advanced toward the bifid fang than in *Protoceratops*, which, according to Brown and Schlaikjer (4, page 208), have a longitudinal groove on the anterior and posterior surfaces into which fit marginal portions of the crowns of the adjacent teeth.

Leptoceratops gracilis Brown. Plesiotype No. 8889, N.M.C. Skeleton, from below, before any bones were removed. About 1/6 nat. size. Cl. clavical, Cor. coracoid, Hy. hyoid, Sc. scapula, St. sternal. (Neg. No. 103481)

HYOID ARCH

Parks, in 1921, was the first to report hyoid bones in the Ceratopsia (12, Plate IV) when he described and figured a pair of rod-like bones, found in the region of the throat of *Centrosaurus apertus*. These he called thyrohyals. In 1933 Lull described what he regarded as part of the hyoid arch of *Triceratops serratus* (11, pp. 37-38). This bone is quite different from the ones described by Parks, and Lull provisionally referred it to the basihyal. In a very informative paper Colbert described and figured two rather broad, flat bones from *Protoceratops*, which he concluded must be the second ceratobranchials, and a fragment that he thought might be part of a first ceratobranchial (6, Figures 3 and 4).

In each of our three specimens of *Leptoceratops*, there is preserved a pair of rod-like bones which are interpreted as the first ceratobranchials (Plate LII, Hy.). They resemble the pair described by Parks as thyrohyals (the mammal equivalent of ceratobranchials), except that they have better finished ends and appear to have been better ossified. They are not L-shaped as in the crocodiles but rather are almost straight with a finished, head-like end anteriorly, and the posterior end is also slightly expanded. It is regarded that in No. 8889 the bones are in their natural position, because this animal appears to have waded into the mud, folded the limbs and feet under him, and died. The skull was right-side-up, and, except for a little crushing of the top of the head, there is no distortion. The anterior ends of the ceratobranchials almost meet near the midline of the throat. From here they extend outward and backward, and the posterior ends are

a little ahead of the posterior ends of the mandible. They are parallel with, and a little above, the lower edges of the mandible. In No. 8887 the skull lay partly on its side and is somewhat distorted. Here the ceratobranchials lie in relatively the same position but are more upright, and the posterior ends lie just inside of, and above, the distal end of the quadrate. In No. 8888 they were slightly misplaced, but they lie between the distal ends of the quadrates and converge anteriorly.

Parks states that his specimens were found "with their anterior ends touching the internal surface of the maxillaries near their posterior extremities, and the posterior ends almost meeting in the midline" (12, page 57). By analogy with the crocodiles and other known reptiles, one would expect the first ceratobranchials to converge forward, and as all three of our specimens of *Leptoceratops* show this to be so, it is assumed that in Parks' specimen they had fallen backward and actually were preserved wrong-end-to. If Colbert's *Protoceratops* specimens (6, Figure 3B) do represent the second ceratobranchials, their position must have differed from the position of these elements in the crocodiles, for there is not sufficient room for such broad bones between the converging ends of the first pair in either of our two specimens of *Leptoceratops* or of Parks' specimen of *Centrosaurus apertus*. In our largest specimen, No. 8889, the left first ceratobranchial is 105 mm. long, the greatest breadth of the head of the bone is 12 mm. and least breadth is 6 mm. Measurements of the right one are very similar (Plate LII, Hy.). The anterior ends are 20 mm. apart, and the separation of the posterior ends is 180 mm. In No. 8887 the anterior separation is 17 mm. They are similar in all three specimens, and the "head" at the anterior end is equally well finished in each.

Behind the first ceratobranchials of No. 8889, on the same plain, near the centre of the broad V, two long slender splint-like bones lay at almost right angles to the long axis of the skull. They are very slightly sigmoid and, in one, the smaller end shows a small partly finished "head". The smaller end of the other, and the broader ends of both are incomplete. They cannot be regarded as ribs, because the complete set of cervical ribs is present considerably above these bones. These bones are thoroughly ossified. There is no resemblance between these bones and the ones that Colbert regards as the second ceratobranchials of *Protoceratops*, nor the second ceratobranchials of crocodiles; yet I have no idea what they could be, unless they represent part of the hyoid arch, and if they do, one would expect them to represent the second ceratobranchials. In the smallest specimen, No. 8887, there are two similar bones lying beneath the cervical ribs (Plate LIII, Hy.). The rounded (? anterior) end of one of these is just behind and beneath the centrum of the fourth cervical. This may represent the left second ceratobranchial, or whatever other part of the hyoid complex is represented by the splint-like bones of No. 8889. The other bone lay beneath the coracoid and seems to have been turned over, toward the right side of the neck.

No part of any of these four bones, in either specimen, has any resemblance to the fragment that Colbert suggested might be a part of the first ceratobranchial, but it would not take much imagination to compare it with a part of the sixth cervical rib of our No. 8889. As Colbert has already considered this possibility, it is most likely that his specimen represents some other element; but if it is a first ceratobranchial, it is quite different from what is regarded as first ceratobranchial in *Leptoceratops*.

MEASUREMENTS OF SKULL

——	Type 5205 A.M.	8887 N.M.C.	8889 N.M.C.
	mm.	mm.	mm.
Length of skull, between perpendiculars		330	450
" " nasal	168+	138	160
" " frontals		93	110
" " parietals		136	175
Greatest breadth of frontals		98	132
" " " parietals	196	120	150
Length of maxilla			180
" " jugal		155	180
" " quadrate		140	135
From back of orbit to back of squamosal		110	150
Length of supratemporal fossa		130	150
Breadth " " "		65	85
Height of lateral temporal fossa		70	80
Breadth " " "		60	60
Length of lower mandible		275	345
" " predentary		132	180
" " dentary	235	150	200
" " exoccipital process		80	140
" " maxillary tooth row			155
" " prevomers			125

PLATE LIII

Leptoceratops gracilis Brown. Plesiotype No. 8887, N.M.C. First five cervical vertebræ and ribs, inferior view. Atlas turned to show posterior face. ×½. Hy. hyoid bones. (Neg. No. 101620)

SKELETON

The presacral vertebræ of No. 8889, Plate LIVB, are all freed from the rock and will be largely used for detailed description of this region. In all three specimens the neural arch is thoroughly co-ossified with the centrum.

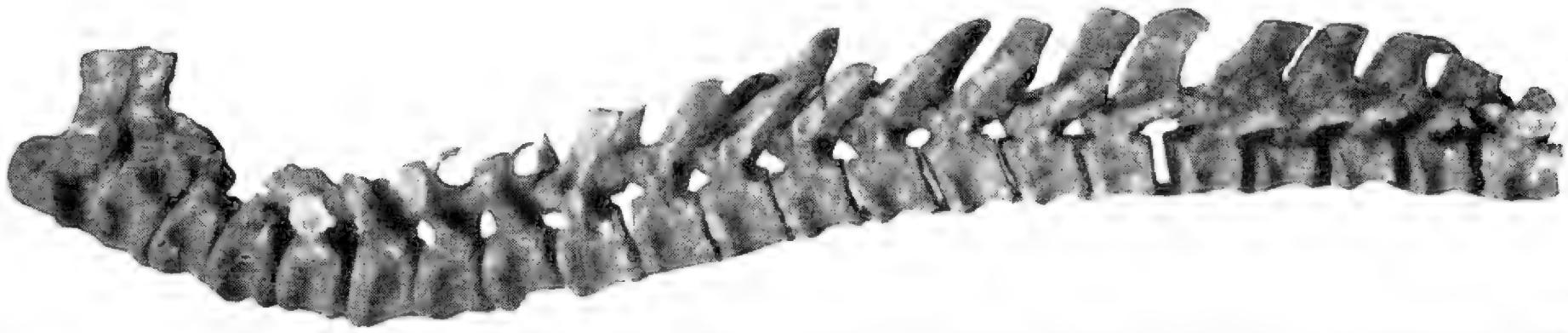
The presacral vertebræ are more primitive than in *Protoceratops* in that the first three are not fused, except in the adult; there is no neural spine on the atlas; the spine of the axis is high but relatively not so wide; number 22 is not fused with the sacrum, even in the adult, but bears a free single-headed rib; there is no hypocentrum in front of the atlas. The anterior face of the centra is slightly concave, and the posterior face is flat.

The atlas is the smallest of the cervicals and is completely without neural arch. It is not fused with the axis except in No. 8889. In the smallest specimen it is much broader than high. This may be partly due to crushing but not all, because the anterior end of the centrum of the axis is also much broader than high, and the anterior ends of three and four gradually decrease in breadth. There is no distortion in these. This feature is well shown in the inferior view of these vertebræ in Plate LIII. This expansion carries the capitular facet for the rib. In the two larger specimens, the centra are as high as wide, though in both of these there is some distortion in the first three cervicals. There is no evidence of what Brown and Schlaikjer call the hypocentrum (4, page 214) or any suture on the anteroinferior surface. The anterior surface is deeply cupped, but in the two smaller specimens the superior surface is less developed than the inferior surface. In the largest specimen the anterior rim of the atlas is equally well developed above and below. In No. 8887 the inferior surface is almost flat, but in the other two it is gently rounded. The atlas carried a slender, single-headed rib. See Plates LIII and LIVA.

The axis is similar to that of *Protoceratops*, but the neural spine is relatively less elongated. Cervicals No. 3 to No. 9 resemble those of *Protoceratops*, but there is no marked difference in the inferior surface, as all show a slight crest which continues onto the dorsal vertebræ but to a gradually diminishing extent, and on the last seven dorsals the inferior surface is broadly rounded. The neural spines are more slender than in *Protoceratops* and are longer on cervicals No. 5 to No. 9. In the smallest specimen they are not so high as in 8889. None of the lateral processes points down. Those on the anterior vertebræ are at right angles to the vertical axis of the centrum, and as they proceed backward they rise very slightly. The lateral processes are at right angles to the longitudinal axis, and they increase in length as they proceed backward. The large, well-defined tubercular facet is on the inferior side of the end of the heavy lateral process on the posterior cervicals. In the dorsals, this facet is at the end of the process.

The dorsal vertebræ differ from those of *Protoceratops* in several respects. The neural spine on the first is only slightly heavier than that of the last cervical, but proceeding backward they become more robust. They increase in height from first to third, and from here back they gradually decrease. The backward slant of the neural spines increases to the third, and from here back gradually lessens, but in none is it as erect as in *Protoceratops*. In all cases, the postzygapophysis and most of the spine overhang the posterior end of the centrum. In the two smaller specimens, the neural spines are relatively higher and not so elongate fore and aft.

A. *Leptoceratops gracilis* Brown. Plesiotypes Nos. 8887, 8888, 8889. Cervical vertebræ and ribs. No. 8888 viewed from right side, the others from the left. $\times\frac{1}{2}$. (Neg. No. 101619)



B. *Leptoceratops gracilis* Brown. Plesiotype No. 8889, N.M.C. Presacral vertebræ, viewed from left. $\times\frac{1}{4}$. (Neg. No. 103483)

The lateral processes are much longer than in *Protoceratops* and in the anterior vertebræ reach up almost as high as the neural spines. They slope upward, outward, and backward, but their backward slant never quite equals that of the neural spine. Their posterior slant increases from first to third, and from here backward they decrease in upward and backward slope, and also in length, so that on dorsals 11, 12, and 13 (numbers 20, 21, and 22 of the series) the short, heavy lateral process stands out at almost right angles to the centrum. The distal ends of the lateral processes are heaviest in the anterior arches, but, proceeding backward, that part beyond the capitular facet is more slender.

The pre- and postzygapophyses are oval to circular in outline. On the anterior arches the prezygapophyses face inward and upward, but in the posterior dorsals they have flattened out so as to face almost directly upward. The zygapophyses are not so widely separated as they are on the posterior cervicals. In the posterior dorsals, the base of the anterior edge of the neural spine is produced forward as a narrow point standing up between the prezygapophyses and extending forward between the postzygapophyses of the preceding vertebra. This point does not articulate with anything but must have added strength to the back.

I have followed Brown regarding as dorsals those vertebræ in which the capitular facet has risen onto the neural arch (See Plate LIVB). In dorsal No. 1, that facet is at the base of the lateral process, but on No. 4 it has moved up to about midway between the base and the tip of the process, and here it remains as far back as dorsal No. 10. In Nos. 11 and 12 the capitulum is nearer the tip than the base, and in No. 13 it has moved to the end of the process, and the two heads of the rib are united making a single-headed rib which stands out from the end of the process. In later forms this vertebra is taken into the sacrum, and the rib supports the ilium. This is the heaviest of the dorsal centra.

In the migration outward of this facet, *Leptoceratops* appears to be more progressive than *Protoceratops*. The capitular facet is oval in outline and cupped to take the convex head of the rib.

The anterior face of the centra is slightly concave, and the posterior face is flat. The anterior centra are broadly oval, with the height greater than the breadth, but the posterior ones are broader than high, with the superior surface flattened and the upper part much broader than below. The neural canal is large and broader than high, especially in the posterior vertebræ.

The sacral vertebræ are not co-ossified in No. 8888, and in the smallest specimen, No. 8887, only the first three (Nos. 23, 24, and 25 of the series) are fused. In No. 8889 all but the first sacral were eroded away before discovery. In the two smaller specimens the transverse processes of the caudals are detached, though the neural arches are all thoroughly united. Numbers 8887 and 8888 may be of about the same age, for, though 8888 is larger, the lack of co-ossification of parts of the sacrum, occipital condyle, caudal vertebra, etc., suggests that it was immature.

Brown and Schlaikjer regard eight as the complete number of sacrals in *Protoceratops* and *Montanoceratops* ("*Leptoceratops*") *cerorhynchus*, but

apparently they regard only six of these as true sacrals, for they state (5, p. 8) that "in *Protoceratops* the greatest width is across the parapophysial ribs of the first 'true' sacral vertebra (the 23rd in the column, or the first of the four comprising the acetabular bar)." In *Leptoceratops*, it would appear that the sacrum never had more than six fused centra, for in the young adult (No. 8889) No. 22 had not yet been taken into the sacrum, and there is no evidence in the smaller specimens that No. 29, the sacrocaudal of Brown and Schlaikjer (4, Figure 25), was part of the sacrum. In *Protoceratops*, No. 22 is fused with the true sacrals before No. 29 is.

In none of our specimens is No. 22 fused with the sacrum, and the short, heavy lateral process carries a single-headed rib which extends under the ilium but is not attached to it. In No. 8887, Nos. 23, 24, and 25 are fused and carry two heavy parapophysial ribs. See Plate LVI.

Brown and Schlaikjer (4, Figure 25) figure the sacrum of an adult *Protoceratops* in which the first parapophysis touches the sacrodorsal (No. 22) and covers most of the side of No. 23. They state that the ventrodistally expanded ends of the sacral ribs, on sacrals No. 2 to No. 5, unite to form the acetabular bar (4, p. 220). In *Leptoceratops* the situation is similar, except that the first parapophysial rib unites with the posterior edge of No. 23 but really is an outgrowth from No. 24, and the sacral ribs that unite distally to form the acetabular bar are from true sacrals No. 2 to No. 5 (Nos. 24 to 27) in 8888 and from No. 24 to No. 28 in 8887. This is one farther back than in *Protoceratops*. The lateral process of No. 23 has no connection with the first parapophysial rib, but the process of No. 24 does unite with it. The union of the five lateral processes and parapophysial ribs to form the acetabular bar, as seen in the smallest specimen, instead of the usual four, is difficult to explain. The greatest width of the sacral complex is across the parapophysial rib of vertebra No. 24, or the second true sacral. In No. 8888 sacral ribs No. 2 to No. 5 are united with the lateral processes of No. 24 to No. 27, though the union of the rib and the lateral process on No. 27 is not so well developed as on the other three. There is no sacral rib on No. 28 in this specimen, but the lateral process supports the ilium. The lateral process of No. 29 does not reach the ilium. This development is the same as seen in *Triceratops*, except that extra centra are taken into the sacrum.

Lull states (11, p. 47) that "in *Centrosaurus* the parapophysis seems to arise from the second sacral and sweep backward so that the pubic peduncle is opposite the centrum of sacral III. Contrary to *Triceratops*, para- and diapophyses are fused in Sacrals III—IX." Reference to Lull's illustration (11, Figure 18) shows that the first parapophysis is spread over the sides of sacrals No. 2 and No. 3, but it is the diapophysis of No. 3 that is united with it, just as it is in *Leptoceratops* and *Triceratops*, and, as in these genera, the acetabular bar is formed by the distal ends of the sacral ribs and lateral processes from numbers 24 to 27 of the series.

The neural spines of the sacrals stand a little above the tops of the ilia, and the anterior and mid-caudal spines are only slightly higher than these. The neural spines of Nos. 22 and 23 are much narrower than the following four. The spines of Nos. 25 to 28 touch each other but are not fused, but from here back they narrow rapidly, and beyond the fifth caudal

they are almost round. When compared with the advanced ceratopsians, the caudal spines are very high, but when compared with *Protoceratops* and *Montanoceratops*, they are of very moderate height.

The lateral processes of the sacral vertebræ are much narrower than in *Protoceratops* or any of the more advanced forms, and they never expand enough to meet each other. They abut against the inner side of the upright ilium near its midheight. This is very different from that seen in *Centrosaurus* and *Triceratops*, where the ilium is strongly everted and the lateral processes united with the inner edge of the broad ilium.

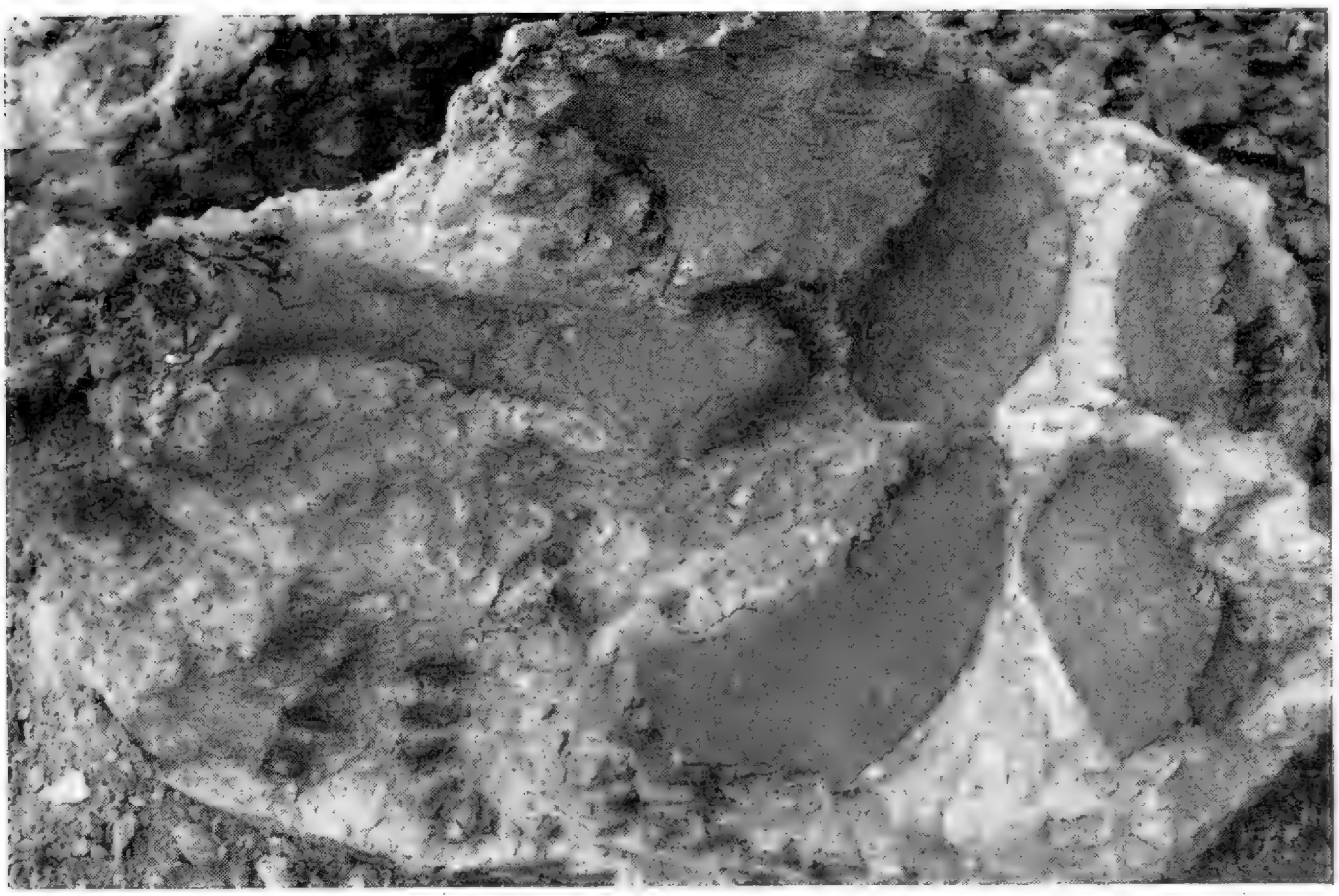
The caudral vertebrae have been well illustrated by Brown (2, Figure 10). The number of vertebræ is not consistent, for although in both 8887 and 8888 the tail is complete to the very tip, in 8887 there are 38 vertebræ, and in 8888 there are 48. In the anterior and middle part of the tail, the neural spines are from two to two and a half times as high as the corresponding centrum. In *Montanoceratops cerorhynchus*, some of the spines are more than five times the height of the corresponding centra. The spines slope slightly backward and continue to within five of the end of the tail, and even the last five centra show the beginning of the neural arch. The chevrons are about the same length as the spines, but they are inclined backward more than the spines. The first chevron is on the fifth caudal and the last within five of the end of the tail. Most of the transverse processes on the anterior caudals had fallen off, but they decreased in size, and the last vestige is seen on the eighteenth caudal.

In all three skeletons, ossified tendons are preserved above the transverse processes near the bases of the neural spines of the dorsal and sacral region, but they do not extend onto the tail in the two in which this region is preserved.

Ribs are present on all presacral vertebræ, and all but the first and last were double-headed. The cervical ribs somewhat resemble those of *Montanoceratops cerorhynchus* as figured by Brown and Schlaikjer (5, Figure 6), but the capitulum branch is considerably longer, and No. 6 is much smaller. In No. 8889, this rib is more slender than Nos. 4 or 5, the tuberculum is short, giving a subrectangular shape to the body of the rib, with the capitulum and distal end extending backward from this central part. In No. 8887 it is more normal in shape but relatively smaller than that rib in *M. cerorhynchus*. The other cervicals and the dorsals do not differ greatly from *M. cerorhynchus* except that on the posterior dorsals the tuberculum is nearer the capitulum. When articulated, the ribs give a very broad back and large abdominal cavity, especially the posterior half.

The sternal plates, Plates LII and LVI, are preserved in their natural position in all three skeletons. They do not differ greatly from those of advanced ceratopsians. Brown was the first to report sternal plates in the Ceratopsia when he figured these elements in *Triceratops* (1). These are relatively wider than those in our specimens but otherwise are essentially the same. The position assigned to these plates by Brown, however, is apparently incorrect. In all three of our specimens of *Leptoceratops*, in a specimen of *Chasmosaurus* sp., in which the coracoids and sternal plates are naturally articulated, Plate LV, and in Brown's articulated partial skeleton of *Centrosaurus cutleri* (3, Plate 17), the broadly

PLATE LV



Chasmosaurus sp. Field photograph showing relative position of sternal bones and coracoids. (Neg. No. 46603)

rounded anterointernal edges meet, and the thin "inner" edges diverge so as to really become the posterointernal edges. Brown shows these edges as meeting on the midline, and the anterior tips as pointing strongly outward. Plates LII and LVI show the arrangement of these plates in *Leptoceratops*, and Plate LV shows their arrangement in a naturally articulated partial skeleton of *Chasmosaurus* sp., as photographed in the field.

The following description of the sternal plates will be based primarily on those of No. 8889, and in their naturally articulated position. Anteriorly they are bluntly pointed and thickened for cartilaginous attachment with the tips of the coracoids. Anteroexternally the bone is slightly concave, and the edge is thickened and rounded, but it thins rapidly toward the posterointernal edge. From the anterior tip, the thin inner edge of the bone sweeps backward and outward, with a broad curve to near its midlength, from whence the edge continues outward and backward almost parallel with the thickened edge. The posteroexternal end is truncated, rugose, and slightly thickened. Cartilaginous ribs may have been attached to this end. The main body of the plate is very thin and the posterointernal edge not always completely ossified. The visceral surface of the plate is only slightly concave, but this may be due to some postmortem crushing.

The position of the coracoids and sternal plates shows that the Ceratopsia had a very narrow chest but, proceeding backward, it broadened rapidly.

Leptoceratops gracilis Brown. Plesiotype No. 8887, N.M.C. Inferior view of skeleton, except head. × 1/6.
(Neg. No. 101961-C)

The pectoral girdle and fore limb have been well described and figured by Brown in his type description (2), and there is little to be added here, except that the humerus should be placed more nearly horizontal.

It is interesting to note that in this primitive form the pattern to toe reduction was already set, for on only the three inner toes were the unguals developed. The principal change in the fore limb and foot, in the advanced forms, was the greater strengthening of all the bones and the broadening and flattening of the ungular phalanges.

The clavicles were not preserved with Brown's type, but they are preserved in our No. 8889. This element was first described for the Ceratopsia by Brown and Schlaikjer in *Protoceratops* (4, page 228, Figure 26). They expressed the opinion that clavicles were probably present in all ceratopsians. As these bones have not been observed in any of the several articulated skeletons of advanced forms, it seems more likely that this element was lost. It was almost certainly absent in all known hadrosaurs.

The clavicles are somewhat boot-shaped, especially the right in which the foot of the boot is much larger than in the left. The foot was inward with the toe pointing forward. The main shank of the bone (the leg of the boot) was slender and lay along the anterior edge of the coracoid but did not reach the scapula, thus differing from those in *Protoceratops* in which the rodlike clavicle lay against the ventroanterior margin of the scapula and the dorsoanterior margin of the coracoid. (See Plate LII, Cl.). The inferior edge is slightly convex and the visceral surface slightly concave. The outer end is bluntly pointed, and both ends are striated.

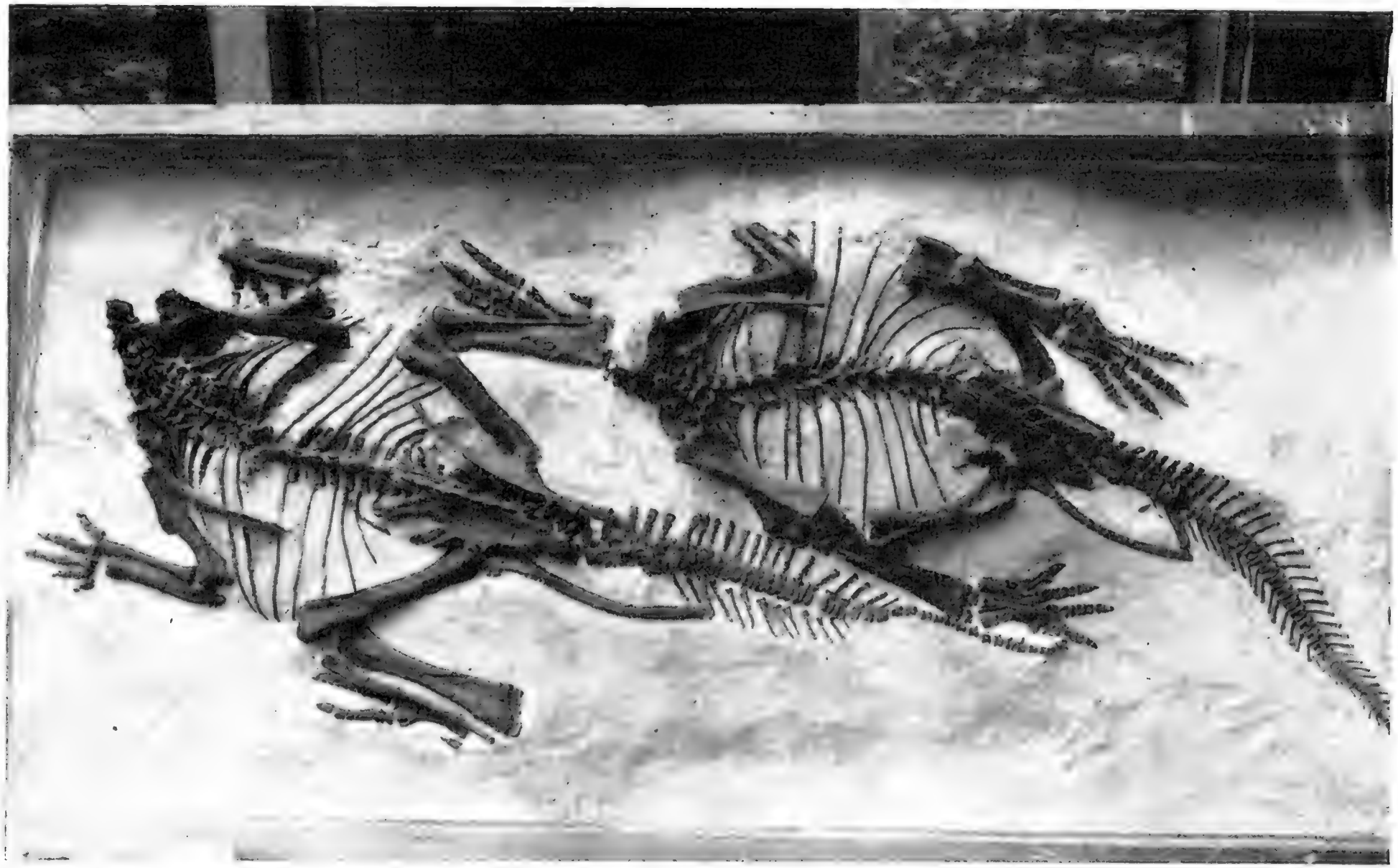
The coracoid is large, and more than half of the glenoid cavity is formed by this element. In advanced forms the scapula makes up much more than half of this cavity. The blade of the scapula is much more slender than in *Centrosaurus* and *Triceratops* but is relatively about the same as in *Protoceratops*, but the ridge on the external surface is less pronounced.

The humerus, radius, and ulna are relatively heavier and shorter than in *Protoceratops* but relatively lighter than in the Ceratopsidæ. The radial crest is much better developed than in *Protoceratops*. In this respect *Leptoceratops* is more advanced than *Protoceratops*. The manus when compared with the pes is smaller than in the Ceratopsidæ. The ungular phalanges become broader with age.

Although the manus is much smaller than the pes, the relative length of the fore limb, when compared with the hind limb, is about the same in all the ceratopsians. In the more advanced forms, however, the limb and foot bones are much stouter, and the pes is relatively shorter.

The pelvic arch is not preserved in No. 8889, but in each of the other two specimens it is complete and well preserved. It is more primitive than in any other ceratopsian. This is especially shown in the structure of the ilium. See Plate LVII.

The ilium is more nearly like *Protoceratops* than any of the more advanced forms, but it is thinner, erect, and does not show any evidence of the eversion of its dorsal margin. The anterior projection curves outward only slightly, and there is no ventral shelf near the tip. The whole of the superior border stands erect, and it is smooth, and the external surface



Leptoceratops gracilis Brown. Plesiotypes Nos. 8887 and 8888, N.M.C. Superior view of skeletons, less skulls, as mounted. About ½ natural size. (Neg. No. 103486½)

is relatively flat and smooth. The postacetabular blade narrows gradually as it proceeds backward. This is much narrower than in *Montanoceratops cerorhynchus*.

The pubis is similar to that of *Protoceratops* but is relatively smaller.

The ischium resembles that of *Protoceratops*, but the distal end is not expanded, and there is no groove on the internal surface of the dorsal margin near the base of the anterior end, as described by Brown and Schlaikjer in *Protoceratops*. The pubic peduncle is longer and more slender. The whole ischium is much more slender than that of *M. cerorhynchus*, (5, Figure 7B).

The hind limb is more massive than in *Protoceratops*, but in its femorotibial ratio and the structure of the foot, especially the unguals, it is fully as primitive as *Protoceratops*.

The femur is shorter than the tibia. In advanced members of the Ceratopsidæ the femur is much longer than the tibia. The head points more strongly inward than in *Protoceratops*, and the lesser trochanter is quite distinct from the great trochanter and almost as high. The fourth trochanter is well above midheight and well pronounced.

The tibia and fibula do not differ greatly from these bones in *Protoceratops*, except that they are slightly heavier.

The astragalus and calcaneum are as in *Protoceratops*, and there are two good-sized distal carpal bones at the top of metatarsals III and IV. The pes is relatively longer, and the ungular phalanges are longer and narrower than in *Protoceratops* (4, Figure 33), and relatively very much more slender than in the Ceratopsidæ. In the two smaller specimens, Nos. 8887 and 8888, the unguals are much narrower and more pointed than in No. 8889. The foot that Brown and Schlaikjer illustrate as representing *Leptoceratops* (4, Figure 33B) was drawn from the U.S. National Museum specimen and, as shown above, does not belong to *Leptoceratops*. This foot is about the same size as our smallest specimen, but it is relatively more slender, and the unguals are not quite so pointed. The slender foot and pointed unguals may be characteristic of juveniles of primitive forms, though Brown and Schlaikjer did not find any such narrow unguals in their large series of *Protoceratops* specimens. The unguals, especially, show that *Leptoceratops* was more primitive than *Protoceratops*.

The pes is long and compact as in *Protoceratops*, but metatarsal I is relatively longer and more slender. It is very much longer and more slender than in *Centrosaurus* and other advanced forms. Also, in the advanced forms, the distal end of this metatarsal is turned strongly outward so that this toe is splayed. The same is true, to a lesser extent, with metatarsal IV. In *Leptoceratops*, the distal end of metatarsal IV is deflected, and the external edge of the bone is concave, but in none of the articulated feet are the toes splayed as they are in *Centrosaurus*.

In the younger animals, the phalanges are relatively thick, and the ungular phalanges are long, narrow, and sharply pointed. In the young adult, No. 8889, the phalanges are broader but thinner, and the unguals are rather broad and flat but much narrower than in *Protoceratops* (4, Figure 33A). The fifth toe is represented by the vestigial fifth metatarsal, as in all members of the Ceratopsia.

MEASUREMENTS OF SKELETON

—	Type 5205 A.M.	8887 N.M.C.	8888 N.M.C.	8889 N.M.C.
	mm.	mm.	mm.	mm.
Length of first three cervical centra		71	81	70
Articulated presacral vertebrae		535	600	690
" complete column		1,350	1,660	
Length of scapula		225	260	
" " ilium		245	305	
" " pubis		100	125	
" " ischium		320	375	
" " humerus	290	185	255	242
" " ulna	224	145	175	190
" " radius	167	115	137	160
" " digit III of manus		40	50	60
" " metacarpal I		30	30	35
" " " II		40	50	50
" " " III		43	45	45
" " " IV		25	30	
" " " V		19	19	20
" " femur		230	265	270
" " tibia		240	280	290
" " fibula		225	260	280
" " digit III of pes		105	130	140
" " metatarsal I		64	77	85
" " " II		90	110	125
" " " III		100	125	135
" " " IV		90	112	110
" " " V			30	30

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THE LIZARD CHAMOPS FROM THE WAPITI FORMATION OF NORTHERN ALBERTA: POLYODONTOSAURUS GRANDIS NOT A LIZARD

By C. M. Sternberg

In June, 1947, Mr. Robert Cochrane of Grande Prairie, Alberta, forwarded to the writer, for identification, some specimens that he had collected from the Upper Cretaceous near his home.

The most important specimen was part of a left dentary with three complete teeth and roots of three others, and the incomplete splenial, all beautifully preserved and without distortion. I identified it as *Chamops* cf. *segnis* Marsh and then forwarded it to Dr. L. S. Russell, Director of the Royal Ontario Museum of Palæontology, for verification. The following

PLATE LVIII

(Left) Part of left dentary of *Chamops* cf. *segins* Marsh, external view. Cat. No. 8891, N.M.C. ×3. (Neg. No. 101964); (Right) Same specimen. Internal view. ×3. (Neg. No. 101965)

is his report: "The specimen is a fragment of the left dentary, coronoid and splenial, with three complete teeth and remnants of three others. It is very similar in form and size to the corresponding parts of *Chamops segnis* Marsh, supposed iguanid lizard from the Lance formation. The Grande Prairie specimen suggests a jaw relatively more massive than the Lance material described by Marsh and Gilmore. *Chamops denticulatus* Gilmore, which has also a massive dentary, is smaller in size than the present specimen and has the teeth less protruding from the dentigerous margin. If the present specimen had been found in the Lance formation it would have been referred to *C. segnis* without much question."

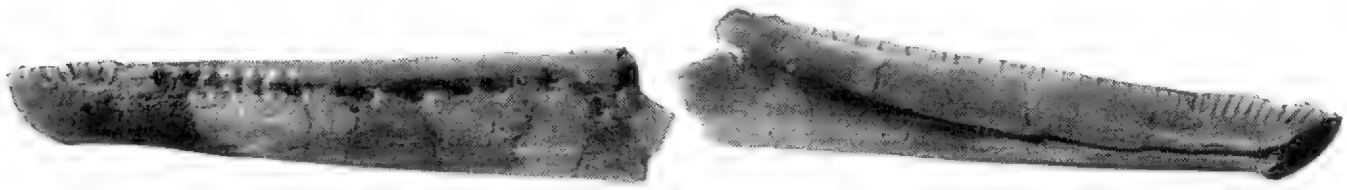
As this extended the geographical range into Canada and the geological range downward, Mr. Cochrane kindly presented the specimen to the National Museum.

The specimen was collected from Kleskun Hills, northeast of Grande Prairie. Allan and Carr (1) place the Kleskun Hills beds in member B of the Wapiti formation which they correlate, tentatively, with the Edmonton formation, farther southeast. Their chart (1, Table 1) shows 2,500 feet of Wapiti formation above member B. This means that our specimen came from well down in the Wapiti formation, thus extending

the geological range downward considerably. I saw the Kleskun Hills area in 1948, but no diagnostic fossils were located. The general lithology was similar to the Middle Edmonton member on Red Deer River (6).

The great difference in age and the more massive proportions of the specimen might justify regarding it as a new species, but it is thought better for the present to regard the Kleskun Hills specimens as representing *Chamops* cf. *segnis* Marsh. Plate LIX gives a fair idea of the specimen.

PLATE LIX



(Left) Type of *Polyodontosaurus grandis* Gilmore, Cat. No. 8540, N.M.C. External view. ×½. (Neg. No. 72079); (Right) Same specimen. Internal view. ×½. (Neg. No. 72080)

Left shows the external view and right the internal view in which the splenial is well shown. The total length of the specimen as preserved is 9 mm., and three teeth occupy a space of 3 mm.

Polyodontosaurus grandis Gilmore

In 1928 I collected a left dentary which I regarded as an undescribed carnivorous dinosaur. The bone was beautifully preserved, but all the teeth had fallen out of the sockets. I showed this specimen to Dr. C. W. Gilmore, and he told me that it represented a lizard. I, therefore, turned it over to him for study, and he described it as the type of a new genus and species of lizard, *Polyodontosaurus grandis* (3).

The general shape and proportions of the dentary, with the narrow but open Meckel's groove reaching the symphysis, numerous foramina on the external surface, and teeth in well-defined separate sockets suggest a carnivorous dinosaur.

Recently Dr. L. S. Russell (4) has described and figured a left dentary of *Troödon formosus* Leidy and has shown that it is a carnivorous dinosaur. His specimen shows the same characteristics as shown in Gilmore's type of *Polyodontosaurus grandis.* I have examined Russell's specimen and compared it with the type of *P. grandis* and am convinced that they belong to the same family, if not to the same genus. Russell's specimen is much smaller and possesses fewer teeth. This may be from a young animal, for it is known that in several of the ornithopod dinosaurs, the number of teeth increase with the age of the individual, and this may also have been so in the Theropoda. Russell's specimen is relatively deeper, and the superior edge is strongly arched, whereas the superior edge of Gilmore's type is straight and almost parallel with the lower edge. This, also, may be individual or age variation. However, until more is known about these species, it is best to retain Gilmore's genus and species, *Polyodontosaurus grandis,* but it certainly must be referred to the Troödontidæ, as defined by Russell (4, page 629).

The very peculiar pes of *Stenonychosaurus inequalis* Sternberg (5), which was referred to the Coeluridæ, and the equally unusual teeth of Troödon might lead one to speculate that when the complete skeletons are known they may prove to be closely related, but in the light of our present knowledge no such conclusion can be reached.

It is noted that Camp and Vanderhoof, in their Bibliography of Fossil Vertebrates, 1928-1933, place *Stenonychosaurus inequalis* in the Ornithomimidæ (2, page 469). This does not appear to be justified, because, as pointed out in my description of the genus and species, *S. inequalis* resembles the Coeluridæ in that the distal ends of the metacarpals are deeply grooved, and metacarpal one is short and strongly divergent; whereas in the Ornithomimidæ the metacarpals are subequal in length, and the distal ends are rounded. Also, in our type, metatarsal III is not broadly expanded distally, nor is the shaft of the bone triangular in cross-section and pinched out in its proximal part, as is seen in the Ornithomimidæ. These differences are so outstanding as to show rather conclusively that *Stenonychosaurus* does not fall in the family Ornithomimidæ.

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WHITE WHALE AND OTHER PLEISTOCENE FOSSILS FROM THE OTTAWA VALLEY

By C. M. Sternberg

In the February 1907 issue of the Ottawa Naturalist, J. F. Whiteaves reported the discovery of remains of the White Whale or Beluga in Pleistocene deposits at several localities in the St. Lawrence and tributary valleys. Among these was a fine skeleton of a very young Beluga found in a clay bed when a well was being dug near Pakenham, Ont. This appears to be the only skeleton previously reported from the Ottawa River Valley.

On June 19, 1948, Mr. S. G. Carr-Harris telephoned the National Museum that the skull and partial skeleton of some fossil had been dug out of the R. R. Foster sand pit near Uplands Airport, about 5 miles south of Ottawa, by Mr. J. B. Rolland, the shovel operator. The specimen, which proved to be the skeleton of a White Whale (*Delphinapterus leucas*), consisted of a splendidly preserved skull (minus lower mandibles), 20 vertebrae, several ribs, a scapula, humerus, radius, and various other bone fragments. It is probable that the complete skeleton was present originally but that part of it was removed with excavated material before the specimen was discovered. The specimen was preserved near the centre of a thick bed of fairly clear sand. A few days later the lower jaw of a smaller individual was recovered from the same locality.

G. G. Simpson (A.M.N.H. Bull. 85, 1945) places *Delphinapterus* and *Monodon* (Narwhal) in the family Monodontidæ, Gray. Like most of the fossil forms found in the late Pleistocene deposits of the Ottawa and St. Lawrence Valleys, the Beluga or White Whale is living to-day. It is quite common in the estuary of the St. Lawrence River and is sometimes seen above Quebec City. Adults average 12 to 14 feet long, though some old males may attain a length of 17 feet.

It is the generally accepted theory that during the Pleistocene the great weight of ice depressed part of eastern Canada to such an extent that when the ice melted and before the country was re-elevated, the sea invaded the St. Lawrence and Ottawa Valleys to well beyond the present city of Ottawa. What is locally known as "the Sand Pits" represents the shore or beach deposits of this invasion, known as the Champlain Sea, and is of postglacial age.

The following less-complete specimens of Pleistocene mammals, which have been presented to the National Museum, are worthy of mention: Caudal vertebra of *D. leucas* from Leda clay, 25 feet below surface in Ottawa East, presented by G. H. Clark in 1909. Caudal vertebra of *D. leucas* from Pleistocene gravels in vicinity of Jock River, southwest of Ottawa, presented by Walter Billings in 1913. Scapula and four vertebræ of *D. leucas* from sand pits, 5 miles south of Ottawa, presented by Dr. Mark McElhinney in 1924. Humerus of Harp Seal (*Phoca groenlandica*) from Odell's brick yard, half a mile south of Ottawa, presented by W. S. Odell in 1905. Two caudal vertebræ of Harbor Porpoise (*Phocoena phocoena*) from a sandy spot at Pontiac Point, a few miles above Ottawa in Pontiac County, Quebec, presented by Hubert Smith in 1937.

Part of a skeleton of a white whale (*Delphinapterus leucas*).

Two discoveries of Pleistocene mammals have recently been reported from the St. Lawrence Valley. In 1947, Dr. T. L. Tanton of the Geological Survey of Canada collected two tibiæ and the epiphysis of a femur from a marly layer 200 feet above St. Lawrence River at Baie Comeau, Quebec. Dr. Remington Kellogg identified these as belonging to the hair seal, *Phoca groenlandica*. During 1947, the newspapers reported and figured part of a large whale that was found near the village of Daveluyville, between Montreal and Quebec. Dr. Kellogg identified this, from a clipping, as probably the finback whale (*Balaenoptera physalus*).

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